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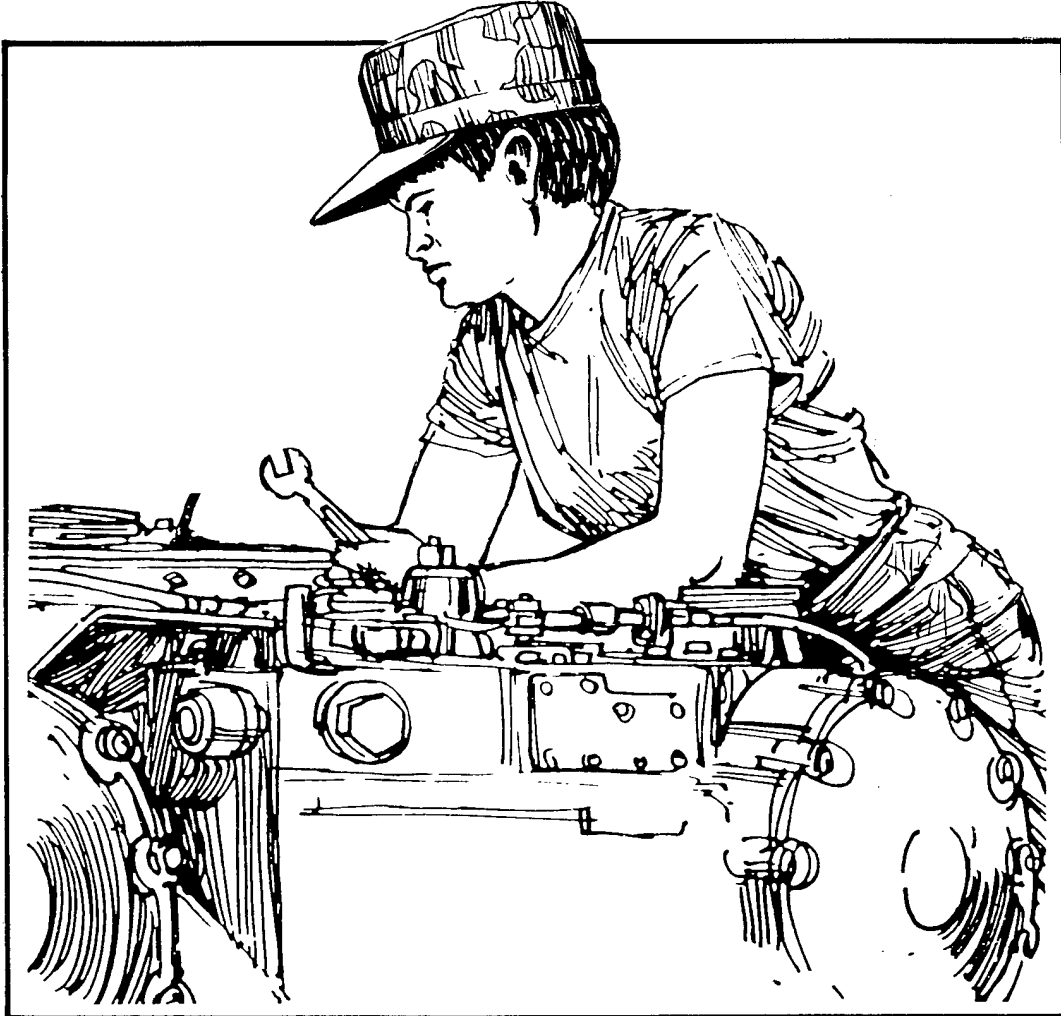
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February 1991

Maintenance Safety Reader



A collection of articles from *Countermeasure*
dealing with Army motor vehicle operations



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Maintenance Safety Reader

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Mission Protection Includes the Motor Pool

In today's Army, whether in peacetime or combat, unit mission accomplishment depends on readiness. And readiness is measured by the unit's capability to mobilize all its assets—all its people and all its equipment. Dead-lined vehicles, damaged equipment, and injured people are not combat ready. Therefore, motor pool operations which service vehicles, repair equipment, and provide preventive maintenance, while keeping its members healthy and whole, protect the Army's ability to accomplish the mission.

A prime contributor to motor pool accidents is poor supervision. Even when mechanics have been trained to perform their tasks properly, they still require close supervision and positive motivation. A "just-get-the-job-done-fast" attitude does not contribute to readiness, will probably result in injuries and damage, and produces a job which is neither "done" nor "fast."

The quality of the supervision has a direct influence on the attitudes of the people in the unit. And their attitudes are reflected by their appearance and that of the motor pool. Clean, properly dressed people perform better and feel better about themselves and their jobs. A clean, neat facility is not only free from many hazards and more efficient, but it also helps instill a sense of pride in the motor pool crew.

True, good housekeeping requires work—more work for an already overburdened crew. But the positive results can be dramatic. People care about their performance when they feel cared about.

Good housekeeping, good attitudes, and safe, by-the-book procedures which are developed in garrison will follow the unit to the field. When vehicles remain ready, when equipment works properly, and when personnel are at full strength, the mission is protected.

Make the following common practice in your motor pool.

- Always use the tire cage when inflating tires, and make sure it is used properly.
- Ban the use of gasoline to clean parts or hands. See your S4 to obtain proper cleaning solvents. Keep them in closed containers in a well-ventilated area. And clean up spills immediately.
- Use the right tools for the job. And never use bricks, jacks, or blocks of wood instead of jackstands. See your S4.
- Check the cords on power tools often for cuts or worn spots.
- Lift with the legs, not the back.
- Always wear hearing protection in noise areas. Call your local MEDDAC for assistance.
- Ban the wearing of jewelry of any kind while working in the motor pool.
- Always roll up long sleeves and never wear loose clothing when working around moving equipment, especially vehicle engines.
- Grease pits should be covered or guarded at all times. A simple wood cover or chain barrier can prevent injuries. Also, keep grease pits clean and dry. Working with electric tools or lights in a damp area is asking for trouble.
- Keep firefighting equipment in ready condition at all times. Have the fire department check your area for fire hazards.
- Spray paint only in a well-ventilated area. Spray outdoors if at all possible. Respirator, Paint Spray, NSN 4240-00-368-3150, should be worn by everyone exposed to paint spray. Contact your S4 and reference DA Pam 385-3.
- Always use a face shield when working around batteries, especially while handling or charging them. Immediately flush acid spills with water. And remember, a charging battery produces explosive gases, so keep the area well ventilated.
- Always wear protective equipment while on the job. Your local safety and MEDDAC reps can advise you on what should be worn and when.

Motor Pool Hazards to Expect, Correct

Hazard. Exposure to asbestos from brake linings and clutch facings.

Countermeasures. Brushes or air pressure hoses should never be used to clean clutch

facings, brake linings, or wheel drums. This could cause asbestos fibers to become airborne. This cleaning should be done using wet or vacuum methods. Asbestos is a cancer-causing agent and can also cause lung disease when inhaled. When exposed to asbestos, mechanics should wear a respirator NIOSH-approved for asbestos protection, such as Respirator, Lightweight, Particulate Removing, NSN 4240-00-084-9394. Contact your Preventive Medicine Activity for further guidance.

Hazard. Welding operations include vision and breathing hazards, especially welding on metals covered with paint which contains lead, chromates, or other toxins.

Countermeasures. If you weld, cut, or braze in your motor pool, contact your Preventive Medicine Activity to have your operations evaluated for adequate ventilation and eye protection. If your facility has less than 10,000 cubic feet of space, if its ceiling is less than 16 feet high, or if welding is taking place in enclosed areas, you must provide local exhaust ventilation of 100 fpm away from the breathing zone into the welding exhaust hood. Respirator, Air Filtering for Gas Fumes, NSN 4240-00-099-6939, must be provided in all extensive welding operations both indoors and out. In some cases, air-line respirators must be provided.

Hazard. Exposure to exhaust fumes. Primary exposures in motor pools are carbon monoxide and other toxic gases. The amount of exposure depends on engine size, number of engines in operation, duration of engine operation, and size and construction characteristics of the motor pool.

Countermeasures. Whenever possible, test and tune engines outdoors to avoid buildup of toxic gases in the motor pool. If engine work must be done indoors, use extension hoses, preferably powered local exhaust hoses, to vent exhaust fumes outside. Ensure tight connections and good natural and dilution ventilation.

Hazard. Exposure to noise from engines, air compressors, and generators.

Countermeasures. If you have to raise your voice above normal conversation levels in the motor pool, contact your Preventive Medicine Activity for a noise hazard evaluation. Identify all machinery, vehicles, and shop areas where noise levels exceed 85 decibels and label them with warning stickers, NSN 9905-00-198-2728. Provide hearing protectors, earplugs, or earmuffs and ensure a medical fit. Then enforce their use in your motor pool.

Ground Guide Guidelines

Accident report files at the Safety Center are filled with cases of AMV accidents resulting from failure to use ground guides properly and failure to use ground guides at all. For example:

- While backing a 5-ton truck into its parking place at the motor park, the driver took his eyes off his ground guide just long enough to glance over at the rearview mirror on the passenger's side. When he looked back at the mirror on his side, the driver saw that the ground guide was pinned between the rear corner of the 5-ton truck and the side of a parked truck. He was dead.

- At night under blackout conditions, the three-vehicle convoy took a wrong turn. The driver of a 2 1/2-ton truck, without the help of a ground guide, tried to back up and turn around. As the left front wheel crossed the soft shoulder of the road, the shoulder gave way and the truck rolled down a 6-foot embankment. A passenger in the cargo compartment was killed when he was hit in the head by shifting cargo.

- The ground guide was walking backwards 5 to 10 feet in front of the armored personnel carrier (APC) he was guiding. The ground guide suddenly slipped on the muddy ground and fell into the path of the vehicle. He was killed when the APC ran over him.



AR 385-55 requires that ground guides be used with any vehicle any time visibility is restricted. Make sure your drivers are aware of this requirement and commonsense practices. Warn them about becoming complacent about driving AMVs. Constant alertness is the rule, particularly when backing a big truck or driving a track—especially in confined spaces. Using a ground guide makes it safer and easier.

There are a few things all your people should know just in case they're called on to guide a vehicle. Stress that when guiding, they must stay clear of the vehicle and remain visible to the driver at all times. They must keep themselves at a safe distance from the vehicle—far enough to give themselves time to react and get out of the way if something goes wrong. They must maintain enough clearance to avoid the chance of being hit by the vehicle. And point out the dangers of walking backwards when guiding a vehicle. Doing so increases the chances of stumbling and falling into the path of the vehicle.

Drivers must share the responsibility for ensuring the ground guide's safety by keeping the guide in sight at all times. Stress to your drivers that if they lose sight of their guide, even for a moment, they must stop the vehicle **immediately**.

Using a ground guide whenever visibility is restricted—whether by darkness, rain, fog, or the size or location of the vehicle—will go a long way toward reducing the number of AMV accidents. And using ground guides properly and safely will reduce the number of ground guide deaths and injuries.

Bubble Trouble

A mechanic who had a small cut on his finger washed some machine parts in cleaning solvent. Then, holding the parts in his hand, he dried them by blowing compressed air over them. Shortly afterward, he complained that his body and head felt as if they were going to explode.

At the hospital, his ailment was diagnosed as air bubbles in his bloodstream. The man recovered, but he could have died.

People use compressed air to blow dust and dirt from their clothing or from their hair, and ear and eye injuries have resulted. There have also been cases in which a blast of air playfully directed behind a worker startled him and caused him to fall against moving machinery.

To prevent accidental injuries, remind your workers to observe these precautions when they work with compressed air:

- Wear eye and other special protective equipment required for the job.
- Don't kink the hose to stop the air flow. Always turn off the air at the control valve.
- Check the air hose carefully to make sure it is in good condition before opening the valve to let air into the hose. Turn off valves on both the tool and the air line before leaving a pneumatic tool.
- Avoid using compressed air for any type of cleaning, except as a last resort. In those special cases, the pressure should be reduced to less than 30 psi and effective chip-guarding and proper personal protective equipment should be used.
- Never point a compressed air hose nozzle at any part of your body or at another person.
- Never use compressed air for a practical joke.

—from National Safety Council's Air Transport Newsletter

Motor Pool Operations Prime Hazard Area

Motor pool operations which service vehicles, repair equipment, and provide preventive maintenance are mission essential considering that readiness is measured by your unit's capability to mobilize all its equipment and people. Dead-lined vehicles, damaged equipment, and disabled or injured people are not combat ready.

Motor pool operations are also critical from a safety standpoint because of the high potential for accidents and injuries due to the type of work performed and the tools required. This increase in accident risks demands an equal increase in safety measures.

Long experience has shown that most motor pool accidents are caused by improper, unsafe work procedures.

Even when mechanics have been trained to perform their tasks properly, they still require

close supervision. A "just get the job done fast" attitude leads to accidents, injuries, and damaged equipment and produces a job that is neither "done" nor "fast."

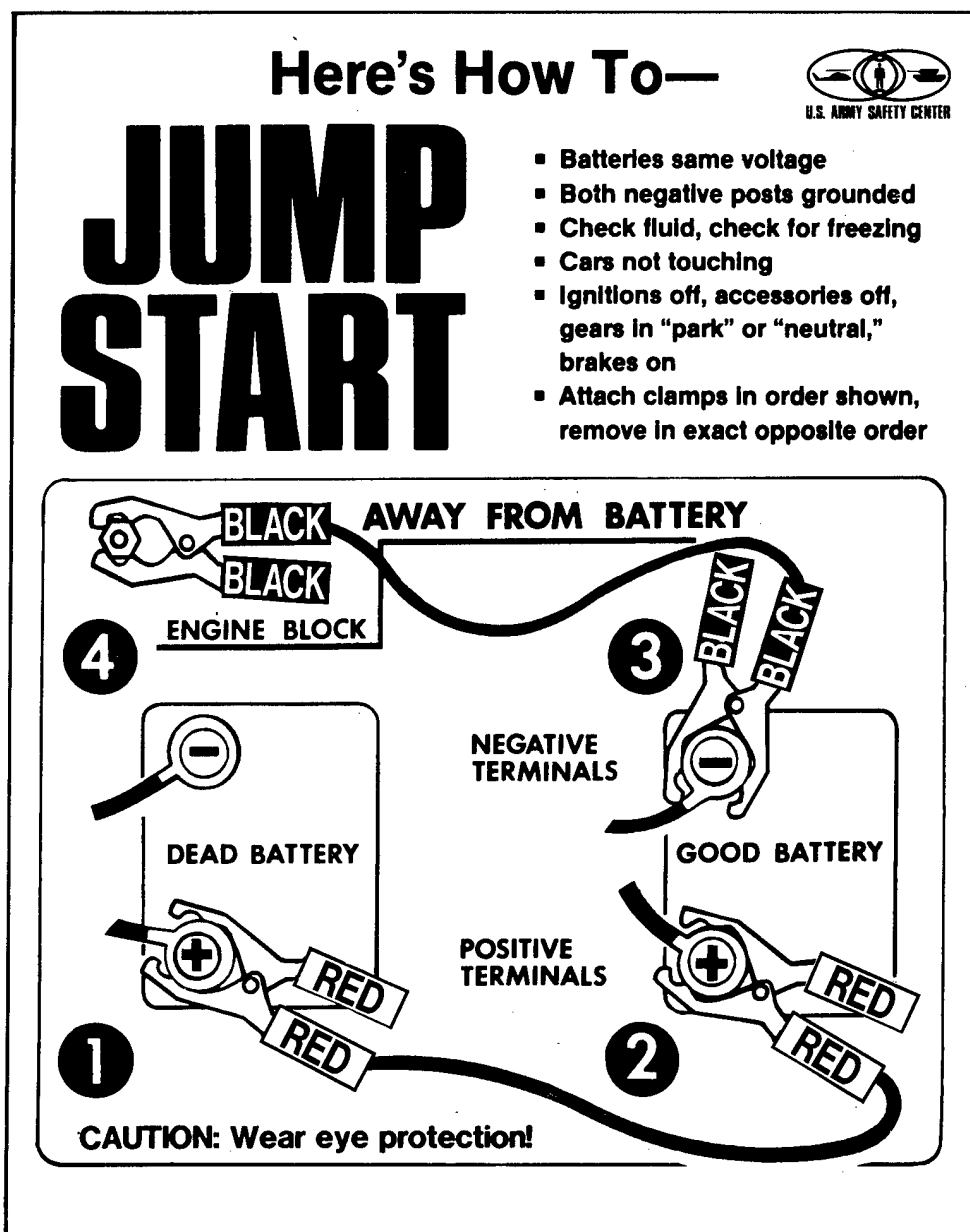
You must insist on strict compliance with safe work procedures no matter how routine the task. Many accidents happen when people perform jobs and/or handle materials to the point that these acts become routine and seem too simple to bother with safety precautions. Many motor pool accidents can be prevented by immediate on-the-spot correction of unsafe work practices observed by supervisors.

Good housekeeping

A clean, neat maintenance facility is not only more efficient and more hazard free, but it also helps instill a sense of pride in motor pool crews. Good housekeeping, good attitudes, and safe, by-the-book work procedures developed in garrison will follow your unit to the field. When vehicles remain ready, when equipment works properly, and when personnel are at full strength, the unit mission is protected.

Make the following common practice in your motor pool:

- Ban the use of gasoline to clean parts or hands.
- Require the use of the right tool for every job and never allow use of makeshift maintenance stands.
- Clean up spills and pick up litter immediately.
- Ban the wearing of jewelry of any kind while working in the motor pool.
- Require the wearing of protective equipment while on the job.
- Keep firefighting equipment in ready condition and easily accessible at all times.
- Check power tool cords at frequent and regular intervals for worn spots or cuts.
- Require the use of a tire cage when inflating split rim truck tires and make sure it is used correctly.
- Keep grease pits covered or guarded by a chain barrier at all times.
- Require crews to roll up shirt sleeves when working around moving equipment,



especially vehicle engines.

- Avoid buildup of toxic gases during engine tests and tuneups. Whenever possible, tune engines outdoors. If work must be done indoors, use extension hoses, preferably powered local exhaust hoses, to vent exhaust fumes outside.

- Provide hearing protectors, earplugs, or earmuffs and enforce their use in your motor pool.

Shop Accidents Big Drain on Readiness

Readiness is always of primary concern in all Army activities. It is the watchword for the conduct of the various operations required to maintain a mobile combat force. Readiness is measured by the unit's capability to mobilize all its assets—people and equipment. Dead-lined vehicles, damaged equipment, and injured soldiers are not combat ready.

A matter of growing concern is the direct drain on combat readiness as a result of accidents in Army maintenance service and repair facilities. On-duty accidents involving military personnel in operations which service vehicles, repair equipment and provide preventive maintenance during calendar years 80 and 81 killed seven soldiers, injured another 1,300, and cost the Army more than \$4.5 million in property damage and injury costs. Add to this another 4,500 accidents with \$5.5 million in injury costs for civilian workers. That's a lot of combat readiness down the drain as a result of so-called minor "routine" accidents.

The following are typical:

- A soldier was trying to fix an air leak on a 20-ton tractor. He loosened the clamps which held the air brake chamber housing. Once the clamps were loosened, the force of the spring behind the housing broke the clamps and propelled the housing into the soldier's face. His nose and upper and lower jaw were broken and several teeth were knocked out. The soldier lost 50 days from work and the accident cost the Army \$4,850.

- A mechanic was jumping up and down on the pipe extension of a wrench. The pipe slipped off the wrench and hit the mechanic in the face, knocking him unconscious. He lost 21 days from work and the injury cost the Army \$1,995.

- A mechanic was installing a transmission in a 2 1/2-ton truck. The locking lever on the cable suspending the transmission was not locked securely and the cable slipped. One end of the transmission swung free and struck the mechanic's hand. His injury caused him to miss 18 days of work and cost the Army \$1,710.

These kinds of accidents usually get little attention and often little in the way of prevention, because, looked at individually, they often seem to be only isolated, "bad luck" events. But looked at collectively, they are a measurement of a serious loss of combat readiness.

Of all Army activities, on-duty military personnel injury accidents in maintenance service and repair facilities ranked second only to combat soldiering activities in total number of accidents last year. For civilians, maintenance service and repair was the single largest category of accidents.

The majority of these injuries were caused by unsafe acts on the part of the individuals involved, primarily failure to follow correct procedures, failure to recognize hazards, and failure to use protective equipment.

Young soldiers 18 to 23 years of age and soldiers in the grade of E4 were most often involved in personal injury accidents during maintenance, service and repair operations.

A review of civilian industrial accident experience shows that the problem of rising personal injury accidents is not unique to the Army. In the Army and in industry, high levels of productivity have become increasingly more difficult to achieve and maintain because of the safety shortcomings of new, young soldiers and civilian workers.

Today, the young high school graduate who joins the Army or becomes an industrial worker has little, if any, training or education in the important and diversified area of safety.

Maintenance service and repair personnel require ongoing accident prevention training and close supervision because their job is not a set activity, but a complex and constantly changing set of problems working with heavy equipment. Today's typical maintenance worker is often in a position where a single mistake can produce an accident of serious consequences, personal injury, and work delays.

Ongoing unit training programs for maintenance service and repair personnel should include

proper handling of the right tool for the job, correct work procedures, the requirements for the use of protective equipment, and hazard awareness. It is important that maintenance personnel know what the hazards are and the reasons for strictly following established work procedures, safety rules and wearing protective personal equipment.

Maintenance repair and servicing operations are critical from a safety standpoint because of the high potential for accidents and injuries due to the type of work performed and the tools required. This increase in accident risks demands an equal increase in safety measures.

The firstline supervisor, more than any other person, holds the key to preventing personnel injury accidents in maintenance servicing and repair facilities.

Check work areas daily and look for unsafe conditions, unsafe acts by your people, and unsafe work procedures.

Demand absolute compliance with safety rules and established work procedures no matter how routine the task. Get out where the action is and look for unsafe conditions. The quality of the supervision has a direct influence on the safety attitudes of the people in your unit.

From a mission protection standpoint, accidents during maintenance service and repair operations are a waste you simply can't afford.

Mission Protection Measures for the Motor Pool

Motor pool operations are a prime hazard area and require constant inspection to reduce risks. Examples of things you should look for in your inspections are:

- Improper lifting.
- Not wearing gloves, goggles, hardhats, safety shoes, respirators, and hearing protection where and when required.

- Potential slipping and tripping hazards such as grease and litter on floors.
- Cords or other obstructions across aisles.
- Barricades left down.
- Worn electrical wiring.
- Climbing on chairs or makeshift stands.
- Unblocked and unchocked vehicles.

Make the following common practice in your motor pool:

- Ban the use of gasoline to clean parts or hands.
- Require the use of the right tool for every job and never allow use of makeshift maintenance stands.
- Clean up spills and pick up litter immediately.
- Ban the wearing of jewelry of any kind while working in the motor pool.
- Require the wearing of protective equipment while on the job.
- Keep firefighting equipment in ready condition and easily accessible at all times.
- Check power tool cords at frequent and regular intervals for worn spots or cuts.
- Require the use of a tire cage when inflating split rim truck tires and make sure it is used correctly.
- Keep grease pits covered or guarded by a chain barrier at all times.
- Require crews to roll up shirt sleeves when working around moving equipment, especially vehicle engines.
- Avoid buildup of toxic gases during engine tests and tuneups. Whenever possible, tune engines outdoors. If work must be done indoors, use extension hoses, preferably powered local exhaust hoses, to vent exhaust fumes outside.
- Provide hearing protectors, earplugs, or earmuffs and enforce their use in your motor pool.

Preventing Slips and Falls

Slips and falls are a leading cause of injuries in the Army. Although the problem is well recognized, accident statistics show little improvement in this area of safety. Despite technological growth in materials, applications, and human factors, workers continue to slip and fall in workplaces.

Firstline supervisors have a twofold responsibility to your troops in the prevention of falls.

One is to see that the work area is free of all conditions that are conducive to falls. The other is to motivate employees to exercise care to prevent falls. The following ideas may help you improve safety in your workplace:

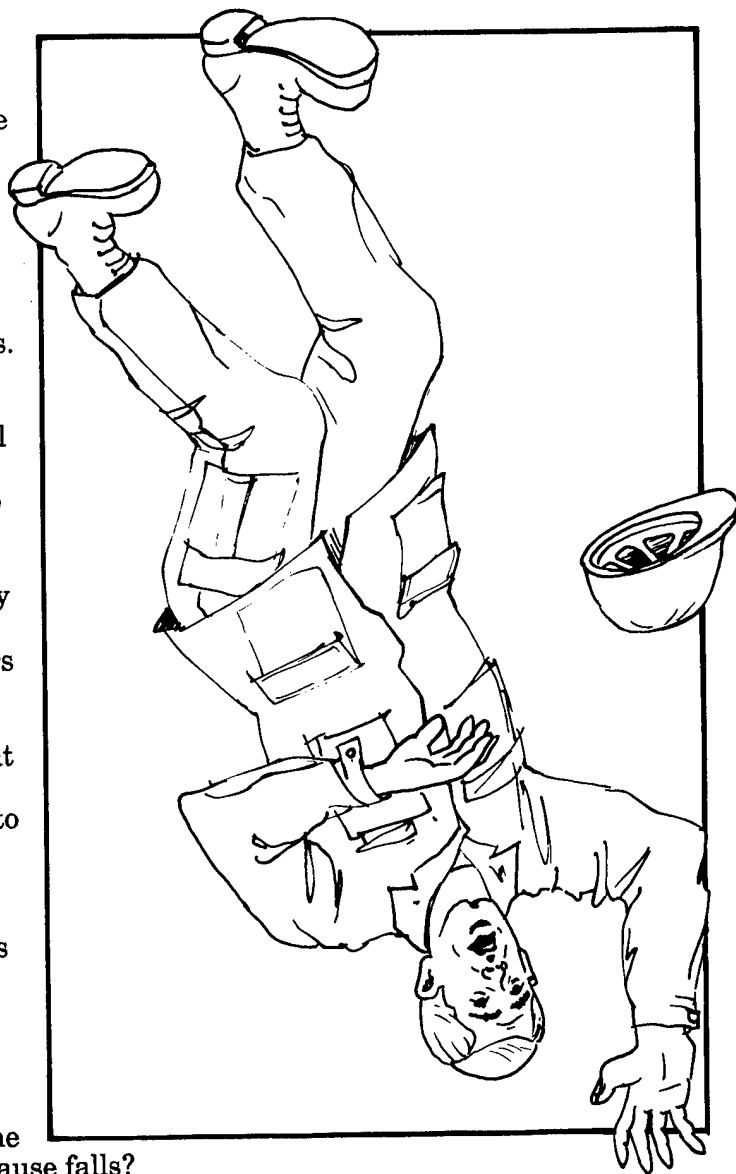
- Safety train new soldiers regarding prevention of falls.
- Advise your troops of their responsibilities and their rights to report unsafe conditions and practices to supervisors.
- Perform routine inspections to detect conditions that might cause falls.
- Make use of available safety promotional material.
- Encourage supervisors and employees to report any unsafe condition.

Ladders and scaffolds should be given special attention because of the usual severity of a fall to a different level. The things that caused serious injuries from falls from ladders and scaffolds should be remembered:

- Ladders placed on uneven ground.
- Ladders propped up against fixtures that were not strong enough to support them.
- Planking on scaffold not strong enough to hold weight of workers.
- Lack of toeboards and adequate guardrails on scaffolds.
- Carrying materials up and down ladders instead of using a rope to raise and lower them.

Read the following supervisor's checklist and see if there are any areas that can be improved in your maintenance facility:

- Is the soldier frequently reminded of the need to correct conditions that are likely to cause falls?
- Are hazardous areas marked in such a manner that the soldier will recognize them and protect himself?
- Is the soldier trained and encouraged to call attention to conditions that create opportunities for falls?
- Is the soldier careful to wear clothing and shoes that reduce the likelihood of falls and fall injuries?
- Are slippery conditions caused by ice, snow, water and liquid spills corrected promptly?
- Are parking lots and other ground areas kept as level and clean as possible?
- Are floors kept free of accumulations of materials that produce tripping hazards?
- Are floors kept free of unnecessary holes, cracks, and other defects?
- Are shop floors kept free of wires that create tripping hazards?
- Are floorboards, walkways, and floor covers securely placed and maintained in good, safe condition?
- Are pits and holes refilled, covered, or protected by barriers?
- Are non-skid surfacing materials used wherever needed?
- Are supplies and equipment arranged to eliminate tripping hazards?
- Are aisles, walks, paths in shops kept open for traffic?
- Are shop and work areas and outdoor housekeeping good?
- Do all ladders conform with standards?
- Are all ladders inspected at periodic intervals?



- Are ladder rungs and stair treads sound, clean, and free of paint?
- Is there an enforced program for ladder storage and protection?
- Are ladders equipped with safety devices such as non-skid safety shoes and locking hinges?
- Is the correct ladder selected for the job at hand?
- Are the bottoms of ladders placed on sound surfaces and securely braced before being mounted?
- Are fixed ladders and stairs anchored firmly to supporting structures?
- Do scaffolds have proper toeboards and guardrails, and is planking strong enough and installed properly?
- Do handrails have sharp, splintered edges, and rusty or oily surfaces that reduce their usefulness for protection?
- Are stairs well lighted?
- Are stair tread surfaces slip-resistant?
- Do ramp and inclined surfaces provide good traction?
- Are handrails provided for ramps?

Safety Tips for Maintenance Personnel

- To prevent back and spine injuries in case of falls, tools should be carried at the side, instead of in the back, position of the belt.
- Gloves or hand leathers should be worn when handling rough or sharp objects such as winch cables. Welding gloves, rubber and leather gloves for electrical insulation, and appropriate gloves for handling acids should be used as needed, but never worn around moving machinery.
- Goggles should be in every maintenance tool kit. Moreover, unless the repair crew knows the exact conditions they are to work under, their equipment should include necessary types of goggles to provide protection against flying objects and molten metal, injurious heat and light rays, dust and wind, and acid splashes.
- When soldiers must work in high places, they should wear a life belt with the life line attached either to some permanent support or held by another soldier. In any case, on jobs involving such risks, an extra soldier should be stationed close by.
- To prevent hands from slipping, maintenance personnel should carry a piece of rag in their pockets to wipe off excessive oil on pipes and fittings. Gloves should be worn when handling pipes and fittings, especially when ends are threaded. Pipes should be checked for burrs, and these should be filed off immediately.
- After a machine has been repaired, it should, if possible, be turned over first by hand. Misplaced tools or materials may then be discovered in time to prevent their wrecking the machinery and perhaps causing injury. Guards should be replaced and securely fastened, tools picked up, and the work area left as nearly in its original condition as possible. The repair crew can aid greatly in preserving good housekeeping. Too much emphasis cannot be given to the fact that guards are a part of the machine and must be replaced before ending a job.
- A tool box or display board with a special rack for each personal tool should be used so the repair crew can quickly see when a piece is missing. Also, a tool check system will keep track of special tools used for the job.
- Machine tools should be arranged to assist the maintenance crews in easy flow of work. Hoists should be available to handle heavy machinery, and power or hand trucks to transport material from one location to another.
- The maintenance shop should be well ventilated, especially if welding, paint spraying, or cleaning of metal parts of machinery is done in the shop.
- Ensure that all fire extinguishers are placed in areas where they are easily accessible and marked with bold arrows in bright colors so they can be seen and obtained quickly if a fire should start. Stress to your maintenance personnel that each one of them needs to know the phone number of the local fire department should a small fire get out of control.
- Maintenance procedures should be reexamined periodically for safer ways to do the job.

Safety Ideas

The following safety ideas were published in *National Safety News* and were Hartford Loss Prevention Award winning articles. These ideas may be beneficial to your maintenance operation and assist your soldiers in reducing both personal injury and property damage.

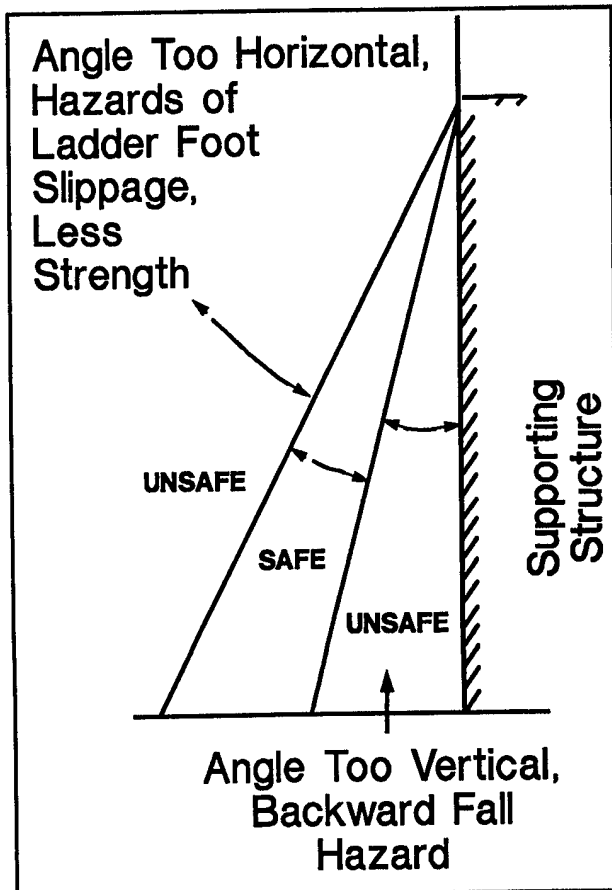
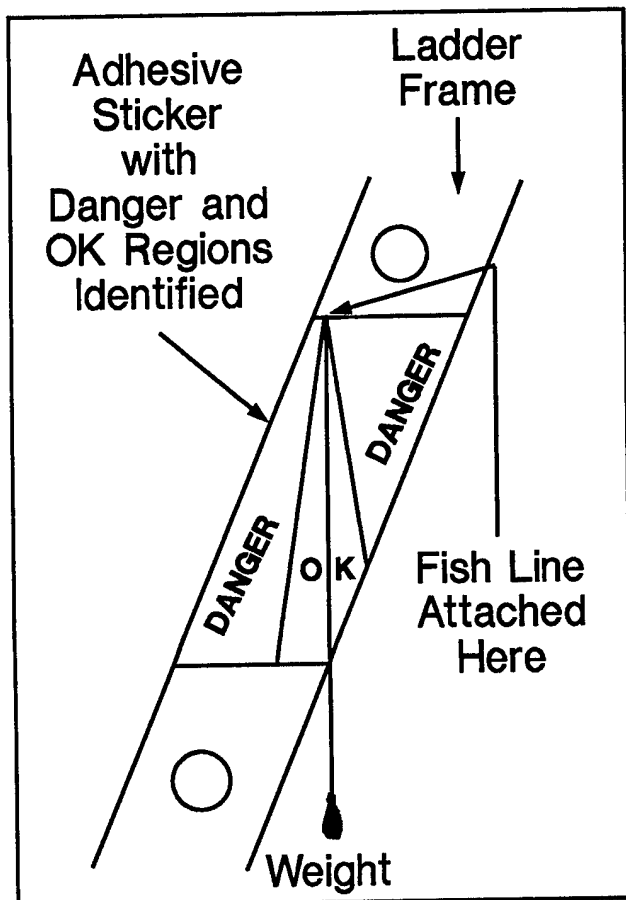
Simple ladder improvements to encourage safe practices

Ladder accidents continue to remain at the top of the list of injuries common to maintenance facilities. The causes for these accidents are usually due to the user's inexperience, ignorance, or absent-mindedness. Stress to your personnel that the top two steps of ladders should not be used for stepping because it places a person in a potentially unstable position. The risk of tipping the ladder over, the danger of lost footing and balance, and the lack of an easily grasped portion of the ladder all make these top two steps an invitation to trouble. Even an experienced ladder user will absentmindedly find himself on them, however, and sometimes the temptation to reach just a bit higher will cause deliberate violation of the rule to keep off these steps.

Remember that extension ladders are safe only when propped against supporting structures at proper angles. The user may lean backward or push forward and end up tipping the ladder over if the ladder is too vertical. There is a greatly increased risk that the feet will slide backwards and out from the user if the ladder is too horizontal.

This simple device can be used to help overcome poor judgment and inexperience. A sticker could be affixed that can serve as a guide for ladder angle if a simple plumb line is added to the ladder. This might be as simple as a few inches of fish line with a sinker on the end.

Using ladders safely can reduce personnel injury and provide a safer working environment for your personnel.



Gaining employee acceptance of safety rules

Failure to observe safety rules is recognized as one of the major causes of occupational injuries. The following idea may help improve safety in your maintenance service and repair facilities.

The proposed solution is to have workers write their own safety rules based on personal maintenance-related experience—ways that the workers think they might be injured while performing their job. Workers and supervisors meet and condense the list and come up with accident prevention measures. The result is a job safety analysis conducted by the most qualified persons—the hands-on operators. Many close calls, near misses, and hazards are revealed for the first time.

The program has several advantages: (1) It causes soldiers to take a close look at the safety side of their jobs and increases their awareness of safety rules, and (2) fellow workers and supervisors find the rules easier to enforce because they come from the employee peer group.

Periodically, the procedure should be reviewed to see if the practices are still valid and new operations should be incorporated.

A simple device for reducing fire loss

Imagine this incident happening in your maintenance facility: A small fire develops in the workplace. A soldier runs to the nearby fire extinguisher, returns to the fire, and begins to extinguish it. However, before he can get the fire under control, the extinguisher runs dry because it was only partly full to begin with. The reason is that someone used the same extinguisher previously on another fire and then returned it to its place of hanging. The solution here is a foolproof method of preventing the rehanging of empty or partially charged fire extinguishers in your workplace.

This simple solution could save your facility thousands of dollars in fire damage. The suggested fix is to construct an inexpensive device that physically prevents return of a fire extinguisher to its mounting hook without authorization from designated safety personnel. Such a safety device could be a simple spring lock mechanism that allows the extinguisher to be removed. Removal trips the spring latch, which closes the hook so the extinguisher cannot be rehung without first unlocking the spring latch with a key. Only designated safety personnel would have the necessary key.

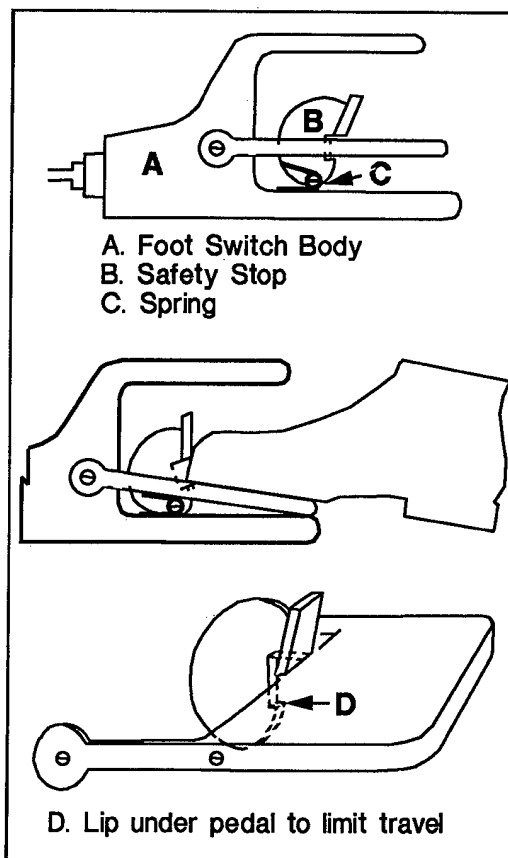
An alternative to the spring lock device would be a one-way turnstile type mechanism. This device would act as a small gate over the hook that allows the extinguisher mounting clasp to pass one-way (off the hook) but not back onto the hook without a key release.

Either of these systems is an effective and dependable way to prevent major fires.

Safety stop on foot switches

Injuries can be caused by the unwanted cycling of equipment by inadvertently hitting foot-operated electrical control switches. In spite of guards, someone or an object can hit the edge of a foot switch and cause the equipment to operate. All too often this results in serious injury.

To solve this problem, consider adding a spring-loaded stop to the foot switch to limit the travel of the pedal. Any tool and die shop could make a model using a purchased foot switch. To operate the switch would require the operator's shoe toe pushing the stop back and then depressing the pedal. Remove the foot, the pedal rises, and the spring-loaded stop again limits the pedal travel. Now someone accidentally stepping on the edge of the switch would not cause a problem.



Users of older switches could have kits added by their tool rooms.

Preventing Back Injuries

Use of improper lifting techniques, failure to use materiel handling equipment when needed, and failure to get help in lifting, pushing, or pulling heavy or awkward items cause most of the Army's back injuries. People often risk back injury by trying to handle a load by themselves rather than take the time to get the help or equipment they need.

Persons who manually handle materials of any type should be instructed in the proper method of lifting heavy objects. The following proper lifting methods were extracted from DOD 4145.19-R-1, Storage and Materials Handling. Incorporate these procedures in your training programs.

Proper lifting method

Persons who manually handle materials of any type will be instructed in the proper method of lifting heavy objects. The proper way to lift heavy objects from the floor is for the lifter to stand close to the load, with feet slightly apart and solidly placed. With knees bent, the object will be grasped firmly and lifted by straightening the legs, keeping the back as nearly vertical as possible.

When lifting from an elevated surface, the object will be brought as close to the body as possible to avoid an unbalanced position. With straight back the lifter will keep the load close to the body and will avoid carrying a heavy load a long distance without resting. The load will be carried in such a manner that full view is permitted.

When lifting with another person, both persons should start and finish the lift simultaneously to prevent undue strain on either person. Persons with existing hernias, or those who have a history of previous back strains, will be assigned to duties that do not require heavy lifting. Lifting or lowering operations performed by several persons will be done on signal from one individual, and only after everyone's feet, hands, and other portions of the body are clear. Generally, mechanical means will be used for handling heavy objects.

Precautions for manual handling

Safety precautions which apply to manual handling of materials include the following:

- (1) Protective clothing or accessories, including gloves, face shields, goggles, and safety shoes will be worn.
- (2) Finger rings will not be worn.
- (3) Material will be examined for sharp edges, protruding points, weakened places of ropes, or other factors which may cause injury to personnel. These defects should be corrected before proceeding.
- (4) All stacked cargo and materials will be arranged in an orderly manner for convenient and safe handling.
- (5) Defective or broken strapping on cargo will be removed, repaired, or replaced. Face shield or goggles and proper gloves will be worn when cutting steel strapping, and personnel will stand out of the way of a snapping line of cut strapping.
- (6) Drums will be rolled by pushing with the hands, not the feet.
- (7) Material will not be thrown from elevated places to the floor or ground. Use suitable lowering equipment.
- (8) Wheelbarrows, hand trucks, and other similar devices will not be overloaded. These devices will be pushed, not pulled except when going up inclines.
- (9) Ropes, used for carrying, towing, or for life or scaffold lines which have defects, will be replaced.
- (10) Chisels, hammer faces, and pliers which have burred, chipped, or badly worn working surfaces or edges will be replaced to prevent serious injury to eyes, hands, or face.
- (11) Appropriate tools will be used for each job. For example, nail pullers will be used for opening boxes, strap or wire cutters for cutting metal strapping or wire, and hammers for driving nails.
- (12) Plugs will be disconnected when electrical power tools are not in use.
- (13) Sharp-edged tools will not be carried unshielded in pockets.

(14) Hand-operated trucks, dollies, and similar equipment will not be parked in traffic lanes or roadways.

(15) Cylindrical objects will be blocked to prevent rolling.

(16) When working at high elevations a lifeline and safety belt will be worn if other safeguards are impractical.

(17) Personnel will not reach around, over, or under the moving part of any machine.

What everyone should know about lifting

1. Never try to lift beyond your own strength. Get help!
2. Always crouch down to what you are going to lift.
3. Get a good footing. Place feet 8 to 12 inches apart.
4. Get a firm grip with fingers underneath the load whenever possible.
5. Keep your arms straight and keep your back in as near a straight up-and-down position as possible.
6. Lift gradually. Avoid jerky motions.
7. Avoid twisting motions by shifting the position of your feet.
8. Lift by standing up or pushing up with the strong leg muscles. This takes the strain off the back muscles.
9. Put things down by generally reversing the lifting methods.
10. Your job may involve handling of cases, boxes, baskets, drums, or shaped containers, under unusual conditions. Check your methods of lifting these with your foreman to make sure they are safe and proper.

Checklist for supervisors

- Identify those people who must regularly lift, push, or pull heavy items. Make sure these people know how to lift properly to avoid strain and that they should always get help with heavy or awkward items.
- Become familiar with the physical requirements of all civilian employee's job descriptions and ensure task assignments do not exceed those requirements.
- Tell people to report any materiel handling requirements which involve strain or risk of injury or damage to the materiel.
- Correct improper lifting techniques on the spot.
- Evaluate operations to determine the need for materiel handling equipment. Indications are employees raising or lowering loads by hand; employees repeatedly carrying loads long distances; and employees pushing or pulling loads without using aids.
- Take action to get needed materiel handling equipment.
- Investigate complaints of back pain to determine whether the cause is job related. If it is, work to correct the problem.

Emergency Eyewash Fountains

The U.S. Army Environmental Hygiene Agency recently published the following guidance on the use of emergency eyewash fountains.

The OSHA General Industry Standards, Title 29 Code of Federal Regulations (CFR), Part 1910.151, states: "Where the eyes or body of any person may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use." This requirement is based on the fact that chemical burns of the eyes need immediate first aid attention. Any delay in treatment will generally aggravate the injury.

The initial treatment of choice is active mechanical flushing of the eyes with an ample supply of water. The American National Standards Institute (ANSI) Standard Z 358.1-1981 for Emergency Eyewash and Shower Equipment states that active irrigation should continue for a period of 15 minutes. This amount of time is considered adequate, depending upon flow rate for even the more serious chemicals; e.g., alkalis and strong acids. All employees with a potential exposure to corrosive materials should be instructed in the proper use of eye-lavage fountains and the length of time necessary to flush the eyes.

Providing 15 minutes of eye/face irrigation requires a considerable volume of water. Based on

information from the ANSI Standard Z 358.1-1981, the flow rate (gallons per minute (gpm)) will not be less than 3.0 gpm for emergency eye/face wash equipment. Eyewash equipment (plumbed and self-contained) will be capable of delivering to the eyes not less than 0.4 gpm for a period of 15 minutes. There is a wide range of injurious materials which can enter the eye and cause injury. The discrepancy between a total volume of 6 gallons and 45 gallons is dependent upon the hazard and its potential effect on the eye and face. Obviously, the larger volume (3 gpm for 15 minutes) is for a strong acid or caustic where it is necessary to wash the eyes and face.

Portable eye fountains generally are sealed units which work on a pressurized system. The tanks are pressured by use of a hand pump. The possible loss of pressure requires increased maintenance checks to recharge if necessary. The unit may fail to function because of a lack of interest in maintenance. Squeeze bottles and other plastic container devices have a water capacity less than the portable pressurized eye fountain and generally will not meet the flow rate and duration prescribed in ANSI Z 358.1-1981. They will often lose water through evaporation and become contaminated because of disuse and poor maintenance. They are easily misplaced and may not be available in an emergency.

Based on the above considerations, the following guidance is provided on the installation of emergency eyewash systems:

- Eyewash squeeze bottles and other such plastic devices are not appropriate emergency eyewash systems and should not be used under any conditions.
- In all areas requiring an emergency eyewash capability, every effort will be made to install permanent eye-lavage fountains of the type described in paragraph 11-3F, DA Pam 385-3, Protective Clothing and Equipment, 3 May 1976.
- No portable eyewash fountains will be permitted in areas where a chemical splash hazard exists and where there is a continuous source of clean water available.
- Portable eyewash fountains may be allowed in remote areas when no continuous flow of fresh water is available, the installation of a fresh water system is not economically feasible, and the hazard to chemical splash is minimal; e.g., in bulk storage areas.
- Self-contained (portable) units will be constructed of materials that will not corrode in the presence of the flushing fluid. The only portable lavage station that will be permitted are those delivering a flow rate of 0.4 gpm for a minimum of 15 minutes duration, and capable of irrigating both eyes simultaneously.
- Eyewash and eye/face wash units will be in accessible locations which require no more than 10 seconds to reach. They should be within a travel distance of no greater than 100 feet from the hazard and should not require a round-about route for access (i.e., up or down steps, in and out various doors or aisles). The maximum time required to reach the eye/face wash should be determined by the potential effect of the chemical. With a strong acid or caustic, the eye/face wash should be immediately adjacent or within 10 feet of the hazard.
- All eyewash units, whether plumbed or self-contained, will routinely be checked. Plumbed eyewash units will be activated weekly to flush the line and to verify proper operation. Self-contained units will be inspected in accordance with the manufacturer's instructions.

Failure of Air Hydraulic Brake Cylinder on 2 1/2-ton Trucks

The following guidance has been furnished by the U.S. Army Tank Automotive Command (TACOM).

Air hydraulic brake unit assemblies, NSN 2530-00-040-2188, are failing because of a defect in the assembly which allows brake fluid to be exhausted through the air hydraulic unit. This causes unexpected brake failure.

To assure safe vehicle operation, it is recommended that before daily use, the master cylinder be checked for loss of fluid using the following procedures:

- Master cylinder should be filled to the bottom thread of the opening before beginning below test. This should be accomplished one time only, and will act as a guide to determine any loss of brake fluid when checked daily.
- Before daily use, with transmission in neutral and parking brake applied, start and idle engine.

- When air reservoir pressure, as indicated by vehicle air pressure gauge, is above 90 psi, apply and release service brake 12 times. (Heavy pedal pressure should be exerted during these brake applications.)

- Measure and record the fluid level in the master cylinder. If there is no change in fluid level from the previous day's check, the vehicle can be considered operational. If there is a fluid change of $\frac{1}{2}$ inch, repeat above functions while observing road tube (vent line from air booster) for fluid leaks. If fluid is seen leaking from the road tube, the vehicle should not be operated until the air hydraulic unit is replaced and/or repaired.



On-hand stocks of unit assemblies (hydra-vacs), NSN 2530-00-040-2188, and repair kits, NSN 2530-00-040-2190, are not to be used until further notification is received from TACOM. A means for replacement of the defective cups and seals in both the unit assembly and repair kit are being developed at TACOM. Specific information on both parts is as follows:

- Unit assembly—those manufactured by Fort Wayne truck parts, under Contracts DAAE07-79-C-7546, DAAE07-79-C-7276, and DAAE07-80-C-7535 have the cup and seal problem and, in addition, may have a rough slave cylinder bore finish. Seal part numbers 7539314, 7539315, and 7529328 will have to be replaced prior to use. Also, the slave cylinder bore must be inspected using the following procedures:

In reference to TM 9-2320-209-34, March 1979, prior to rebuilding air hydraulic cylinder with good repair kit, the following inspections must be performed:

- Slave cylinder piston bores must be inspected for proper surface finish (32 microinches maximum). This may be accomplished by measuring the small bore (1.0640/1.0615) finish, where piston cup, PN 7539328, is located and the larger bore (1.1265/1.1240) finish, where the air cylinder piston pushrod seal, PN 7539314, is located.

- Assemblies determined to be unacceptable for field repair are to be retained until TACOM can investigate the feasibility of a return program.

Repair part kits—those manufactured by Fort Wayne truck parts under Contracts DAAE07-80-C-7131 and DAAE07-80-C-8006 have a cup and seal problem. Seal, PN 7539314, 7539315, and 7539328, will have to be replaced prior to use.

As stated above, TACOM will provide the additional information on the availability of good seals when the details are complete. Stocks of both the good unit assembly and good repair part kits are expected to be available soon. These will be new items. Once received and applied to vehicles, other than normal operational checks will not be required. TACOM POCs are Mr. Robert Leitzel, AUTOVON 786-7465, and Mr. Roosevelt Jones, AUTOVON 786-8503.

Safety and You—Supervision

Year's end seems to lend itself to pondering and taking stock. Between Christmas and New Year's Day most Army units and offices slow down. Time to clean up our desk; time to get those extra jobs done; time to think about **safety**.

"Here it comes again," you say to yourself. "I'm going to get told about all the things I've done wrong."

Not so. We want to talk about safety, and about you, the supervisor, the guy who makes safety work. They go together you know, safety and you.

Every safety program has a single purpose—performance of duty without accident, injury, or work-related illness. You, as supervisor, don't want an accident or injury. Even minor incidents cost time, effort, and, of course, paperwork.

Generally, safety is thought of as a thing: a safety program, a safety lecture, a safety belt. The word "safety" is most commonly used to mean a condition of being safe from undergoing or causing hurt, injury, or loss. A safety program or a safety lecture is designed to keep your soldiers from being hurt or injured. They want safety in the shop, on the road, or in the office. They don't want to be hurt or killed.

But safety also means to protect against failure, breakage, or accident. It is something that must be done.

"Okay, so now that you've told me that, what is the purpose?" you ask.

Did you notice that the meaning is going to depend on who you are and what you are supposed to be doing? If you are the soldier doing the immediate task, from your point of view safety is a condition of being safe, unhurt. However, if you are the supervisor, safety is an action, something **you** have to do. You have to SAFETY your people. Sounds strange, doesn't it?

No one doubts that supervisors (meaning "one who watches and directs the activities or a course of action") want to prevent accidents.

"But," you often say, "I've got a job to do. I don't have time to watch every person every minute. The battalion has a safety officer. Safety is his job."

Don't you believe it! Supervision and safety go hand-in-hand. Making sure that the work area is safe and that the soldier works and acts safely is an integral part of the supervisor's total responsibility. Safety is not something that can be delegated or handed off.

Remember that SAFETY means to protect against failure, breakage, or accident. It's active, not passive, a here and now action.

"Okay, so how am I going to do it?"

First, you must realize and accept that safety is not a part-time thing. Safety is **not** a check-off item. It is daily. Your responsibility to protect cannot be separated from the job to be done. Doing a job correctly is doing it safely. Once you have accepted safety as a part of your everyday duty, then you can protect your soldiers and prevent accidents by—

- Training soldiers in proper work practices.
- Supervising and evaluating a soldier's work and insisting he follow safe practices and by-the-book procedures.
- Following all the safety rules and guidelines yourself. No shortcuts. Actions do speak louder than words.
- Monitoring the work area for unsafe conditions and working to eliminate them.
- Being a safety-minded supervisor reduces losses from accident and injury. As a result, you will have more time to get the job done.
- Take some time. Safety your soldiers.

Maintenance and Supervision

Our thanks to LTC Mark R. Hamilton, Commander, 2d Battalion, 4th Field Artillery, Fort Lewis, Washington, for permission to publish his letter. A few years back, when he was executive officer for the battalion (then Major) Hamilton wrote a letter to his maintenance supervisors. In that letter, Hamilton was concerned about a maintenance "teaching" program.

At first glance you might wonder what that has to do with general safety and especially what it has to do with safety leadership. Look closely. You'll find Hamilton is talking about responsible supervision of personnel. That equates to good safety leadership.

To: Maintenance Supervisors

Managing a maintenance program in a unit where there is little if any driver level expertise is like coaching a football team that doesn't know any plays. You can schedule all the games (or motor stables) you want, but if the basics aren't there, you will accomplish very little.

What follows is neither brilliant nor original. Further, because I have no intention of rewriting 38-750 nor of changing the existing Preventative Maintenance Checks and Services (PMCS), what I give you here is primarily philosophy and helpful hints. If you are completely satisfied with your maintenance program, please stop here and give this article to someone who needs it. If, however, you want to begin or re-energize your program, continue on and see if it makes sense.

First of all, you must believe that establishing a driver's level maintenance program is **easy**. If you don't believe that, you have probably lost sight of the objective. If you check the PMCS in the -10 manual, you will find that a driver is required to do very little in the area of "fixing." In fact, you may be surprised to learn how little battery-level or even battalion-level maintenance personnel are authorized to do in the area of mechanical repairs. You are not attempting a program which will turn your drivers into expert mechanics. What you **are** trying to do is provide the education which will turn what I have been calling "drivers" into what they ought to be called, "vehicle operators." Their job is to make certain that their vehicles are operational.

Operators willingly do

Another reason that your task is **easy** is because your vehicle operators are **willing**. I can prove that.

Go check a 2 1/2-ton truck. On most models, when you check the oil, the dip stick will rub against the air hose. Most air intake hoses you will see are actually frayed by the number of times the oil in that vehicle has been checked (unless this wear is truly excessive, there is no need to replace this hose). While you're at the truck, check the battery box. You'll probably find that the threads of the butterfly bolt which tightens against the battery box clamps are stripped, or at least scarred. Let me tell you why that is good news even though it's not good maintenance.

Your vehicle operator is responsible for the condition of the battery box. In order to clean it thoroughly, he probably takes the battery out. When he replaces it, he tightens the battery hold down bracket too tightly. That, in turn, bevels the bottom of the battery box which causes the butterfly bolts to be raised above the arc of the battery box clamps. What we have is the result of a misdirected effort. The operator has done his part. He's given the effort. The fact that it was misdirected is your fault.

I want to belabor this point one more time because it's the key to both your attitude and orientation as you undertake the teaching of operator-level maintenance. Our operators have been **so** willing to clean their battery boxes that there used to be a major problem with the soft lead of the battery terminal actually being worn away from the nearly daily removal and retightening of the battery terminal clamp. Because of this, the operator is no longer authorized to remove the battery terminal clamp from the battery terminal. The proper technique is the removal of the battery cables from the clamp while leaving the clamp attached to the terminal post.

Your operators are so willing, the Army has had to change the rules to keep them from **over-maintaining** the battery!

Supervisors teach

Well now, you ask, "If my operators are so darn willing, why do I have so many problems in maintenance?" The answer to that question is your mission. Your operators are willing to do what **THEY KNOW HOW TO DO**. If all they know how to do is raise the hood, check the oil and clean the battery box, then you're going to have those things done to the point of creating the problems I've just listed. You're also going to have very bored operators. Your mission is to **teach your operators what is required of them** in order to keep their vehicles in good running order.

How do you go about that teaching? First, your "lessons" should be organized and digestible with plenty of time for "hands on" time. Most of the other classes that are taught at battery level are reasonably well done. There is an instructor, a lesson plan with objectives, and good personnel accountability. Most of the maintenance "training" that is done has none of the above.

Maintenance **has to be taught**. This shouldn't be surprising. We don't hand a man a manual and tell him to become qualified in nuclear, biological, and chemical warfare. But, we do exactly that in our motor pools. We give a man the -10 manual and say "Go to it." Now, the -10 manual is not a bad place to begin in your efforts to isolate blocks of training. It does not, however, stand

alone. While the PMCS listings are very complete, they are not necessarily in the best order for the man doing the checks. For example, if you do the PMCS list in order on the 1/4 ton, you will find you have circled the vehicle several times. There is no reason in the world why you couldn't, with a little effort, divide those checks into "front" and "rear" or "left side" and "right side" checks. The 2 1/2-ton truck divides nicely into "cab," "under the hood," and "underside."

The next thing you have to do is decide on the length of time necessary to perform the training you have outlined. I don't mean the entire program. How long do you want to spend on maintenance training next Monday? That question is often asked and answered with no consideration given to what will be done during that maintenance period.

Start with your objectives, then decide the time you'll need to accomplish them. I often see 4-hour blocks of motor stables. That's a long time to stand around a vehicle. That length of time with personnel scattered over half an acre, working on five or more types of vehicles, requires excellent organization, aggressive supervision, and continuous personnel accountability. In every class where we've pulled a training quality check, one or more of those qualities was missing and often all were missing. In fact, in several cases **you** were missing! What else can you do where you have your entire unit committed for 4 hours without your presence?

You can get insulted if you wish, but I'd rather you thought about that for a minute. I still say a maintenance program is easy, but you have to give it your attention. I know of no other area where there is so much help available. There are films and large-sized training aids to be used by the operators, MAIT teams, IG teams, and higher headquarters. There are step-by-step checklists, -10 manuals, safety checklists, recurring deficiency checklists, and more. Use them all. Use them wisely.

Increase efficiency

In order to use them wisely, be certain you do not begin your program by going backwards. Think about this for a minute. We often use the battalion level **mechanics** to list those items on a vehicle which are to be corrected by the operators and the battery. This is commonly called a "TI." There is nothing wrong with TIs from battalion, but the concept is backwards. The aim of **your** program is to teach your **operators** to **identify** those items which cannot be fixed at their level and must be sent to battery or battalion.

It would take the battalion mechanics a full month to perform a thorough inspection and re-check of every vehicle in the battalion. If those inspections were performed by trained and supervised **operators**, they could be accomplished in one 4-hour period. This is a 4,000-percent increase in efficiency! While the battalion mechanics may know more about the vehicle, they do not have to use all that knowledge to "TI." The level of knowledge required to properly inspect a vehicle is that of the operator. It's not important that the driver be able to report, "The rear differential input seal has a class 2 leak." If we can have a driver write down on a 2404, "On the bar that connects the rear wheels, at the fat part, it has a drop of oil," then **we have a program!** Now we can do better than that. We owe our operators more knowledge than that. However, the point remains that the hypothetical entry on the 2404 is sufficient.

Instill operator pride

As your training level increases, you will want to incorporate some of the many ways to make maintenance training truly enjoyable. Truck rodeos are one method, as are "find all the faults on pre-bugged vehicles" contests. Your operators will enjoy these refreshing training sessions and good maintenance will be pulled at the same time. You really can have drivers looking for the roadside spot checks just to show off.

The other aspects of maintenance such as TAMMS records, scheduled services, etc., will be positively influenced by drivers' interest. When they know more about their vehicles, they will feel that pride of "ownership" which will keep them interested in all aspects of that vehicle's maintenance. Obviously, you will want to assign one man to one vehicle, where possible, so he can feel he "owns" it.

Maintenance is one of the least perishable areas for which you are responsible. Once you get the fleet ready, it will remain that way with relatively little effort. It's worth the time to educate yourself, your soldiers, and to do the job right.

Lead 'Em and Reap

We've all heard the old adage, "Read 'em and weep." That really applies to accident statistics and reports. Lost soldiers, lost hours, and lost equipment. Unfortunately, weeping never really changes any of the statistics nor saves any of the soldiers.

Safety should not rest on a throw of the dice, on chance. Good safety leadership could change that to "lead 'em and reap" more productive hours, better maintained equipment, and increased combat readiness.

In addition, good safety leadership will help you succeed in your unit. A safe and productive unit will give your soldiers greater job satisfaction and a sense of accomplishment. The better leader you are, the more you and your unit will contribute.

Theories and definitions of leadership abound—leaders are born, not made; leaders **learn** to be leaders. Or, perhaps you prefer Harry Truman's statement: "A leader is a man who has the ability to get other people to do what they don't want to do, and like it."

But, whichever theory or definition you follow, they all seem to come back to the fact that one needs skill to be a leader. A number of years back, Robert L. Katz, a professor of business who later helped found five companies and now heads his own consulting firm, focused attention on three performance skills needed by leaders: technical skill, human skill, and conceptual skill.

Technical skill or technical competence has always been important for military leaders. The complexity of modern weaponry demands technical competence in a range of skills and situations that vary depending on the leader's position. But, as a leader you must know the job, the equipment, and be able to use all your resources efficiently to be effective.

Human skill can be defined as the ability to work as a group member and to build cooperative effort within the group one leads. Because of these human skills, your values, attitudes, and beliefs are passed to your subordinates. This is especially true of your attitude toward safety.

People are most likely to follow a leader who embodies what they would like to be. Therefore, you, as a leader, must offer a model of safe behavior for your people to identify with and follow.

Conceptual skill enables you to see how the various functions of the unit depend on one another and how changes in one part affect all the others. This skill is valuable at all levels, but is essential as you reach the position where you must integrate a multitude of complex issues and needs for the benefit of the total organization.

Reasons for either a decline or rise in a unit's accident statistics can usually be traced to leadership, how well you use your skills. People will perform the way they are expected to perform. If you demand professionalism, sound workmanship, and safety discipline, you will get it.

Soldiers expect their leaders to have mastered the fundamentals of their profession. A demonstrated mastery of the needed technical skills gains the confidence of your soldiers.

Show him the safe way to do the job. Don't try to bluff it. Soldiers know. If you say you want safety to be an integral part of the everyday work effort, but you don't ensure that the driver you send out is properly trained, don't put on protective gear when you enter the shop, or don't buckle your seatbelt, the soldier will know your true motives. Every time you act, or fail to act, you convey a sense of what is important. Rules may be laid down by the book, but it remains for you to rule by work and by setting the proper example.

Soldiers want a challenge, they want to do the job well and safely, they want direction and purpose in the task assigned, and they want to be proud of who they are and what they do.

When you fail to properly execute your responsibilities to schedule, plan, and lead, you squander the most precious possession of your soldiers—their lives.

The unit's accident statistics mirror the leader's commitment to safety. Take a look. Do you like what you see?

Don't read 'em and weep; lead 'em and reap the benefits.

Unit Training Makes Good Mechanics

Got new mechanics in your unit? Ever wonder how you ensure or assure yourself that these new guys fresh out of AIT, or even those new sergeants, know their maintenance procedures?

Maybe we can help. Here's a few ideas on how to bring your mechanics, PLL/TAMMS clerks up to speed.

Establish maintenance SOP. Establish a well-thought-out, but brief, overall SOP on how you want your maintenance program procedures carried out by your mechanics.

Assure SOP is read and understood. Make sure your mechanics read the SOP. After they have read it, be sure they understand it. The two don't always work in tandem.

Track each service member's unit training. Start a training folder for each service member. Keep track of his progress through monthly evaluation inserts.

Develop a thorough exam. Based on each individual's MOS, develop a thorough examination, ensuring that the items and procedures he is required to know are thoroughly covered. Use the soldier's manual and technical manuals and make the examination comprehensive enough so a new soldier will not possibly be able to complete it. However, such a comprehensive exam serves as a gauge of the soldier's present level of understanding. Make it open-book style and have all the manuals present for his use. Also, set a time limit and ensure all his work is his own.

Assign new mechanics with experienced. Now that you've determined your new mechanic's level of knowledge, assign him to an experienced mechanic. Outline certain procedures that the old salt can teach him. Stress not only the mechanics of performing a task but the safety precautions that are sometimes so easily overlooked. Leave him with that experienced mechanic until he has demonstrated proficiency on those procedures you initially outlined for him to learn—at least 90 days.

Evaluate SM's progress. Once again, test your service member and evaluate his knowledge and progress. You either continue his on-the-job training phase, release him to perform certain procedures, or certify him as qualified to perform in his MOS. Develop an awards program for these guys; let them know their efforts are being appreciated. A battalion certificate of achievement signed by "the Old Man" goes a long way toward building unit esprit de corps.

This evaluation cycle can be used for the entire duration a service member is assigned to your unit. It can serve as a tool for promotion evaluation, levels of proficiency attained, and, additionally, will serve to prepare the service member for his annual SQT examination.

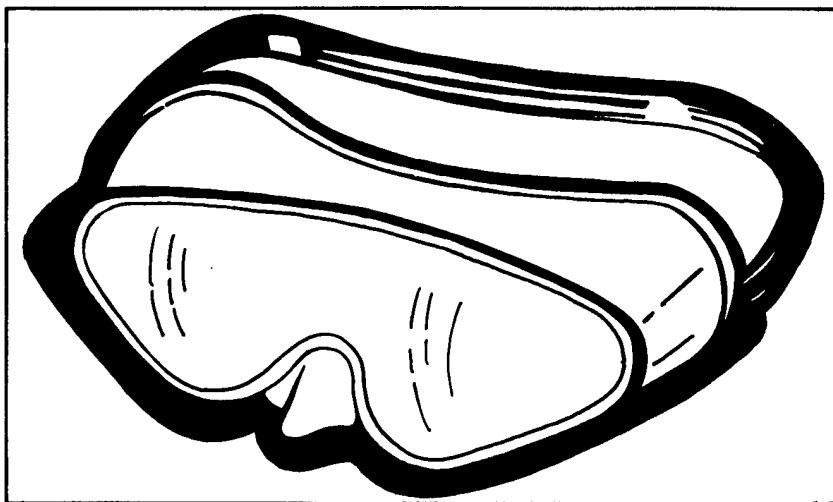
The development of the test by MOS and the determination of levels of proficiency by actual experience exposure will be the hardest items for you, the supervisor, to develop. This approach to unit level training will serve to close that initial experience gap found in our new soldiers. Additionally, the approach establishes a level of awareness for the new soldier that will result in an improved readiness posture of your equipment. But mainly, and probably most importantly, it produces a well-qualified mechanic and a good soldier.

Protect Your Eyes

Do you have any idea of the multitude of ways you can injure your eyes? You could play racquetball and get hit in the eye. You could splash chemicals in your eye. You could try to start a generator and have the starter rope snap back and hit you in the eye.

You could be on the range firing your rifle and have an ejecting cartridge strike you in the eye. You could be drilling a hole in the manifold of your car and have a metal shaving fall in your eye. You could be chopping wood and have a flying splinter strike you in the eye.

You could be lighting an immersion heater and have it flare up and burn your eye. You could be on the sidelines at a softball field and have a ball hit you in the eye. You could be playing waterpolo and



get struck in the eye by an elbow or fist.

You could be cutting nail clinches from a horse's hoof and have a small metal fragment hit you in the eye. You could be trying to hit a fly with a rubberband and have the rubberband snap back into your eye. You could be welding and flash burn your eyes.

These are only a few of the ways in which Army personnel have injured their eyes. Such items prove that eye injuries can strike anyone, at anytime. This, despite the array of protective equipment specifically designed—and usually available—to prevent many of the accidents.

Goggles, safety glasses, face shields, hoods—all will help keep your eyes safe. You should know and use the proper gear for the activity at hand. Sunglasses and sun-sensitive lenses won't protect you when welding or cutting because they don't block out enough near-ultraviolet and infrared light.

Contact lenses are no substitute for safety eyewear. Not only do they fail to provide protection, but they also may be a danger if dust or chemicals get caught between the lens and the eye. Any worker who wears contact lenses must also wear the appropriate eye protection.

It's important that eye protection fits well and is comfortable. Badly fitting eye protectors don't protect, and uncomfortable eye protectors aren't worn.

If you're the supervisor, it's your responsibility to be certain that eye protection is readily available, that your people understand the need for eye protective equipment, and that they have been trained to use the correct eye protection for the assigned job. The person who's ultimately accountable is the one whose vision may be lost if an accident occurs.

No eye protection can protect you unless it is used. So wear that eye protection, and make sure your people do too.

Some eye care safety advice

- Wear your goggles or shield when working.
- Keep your eyes out of line of work in case a tool should break.
- When opening containers that hold acids or other type liquids, be sure your face is turned away from the top of the container.
- In grinding operations try to keep your face a safe distance from the work area.
- If you must remove your goggles and you are working with power tools, be sure the tool is turned off.
- Never wear cracked, pitted, or damaged goggles or spectacles. Turn them in for a new pair.
- Do not engage someone else in conversation while working with power tools. Keep your concentration on the job at hand.
- Don't wipe your face and eyes with dirty hands which might have some chips or particles clinging to them. The same applies to handkerchiefs.
- If you feel your eyes becoming strained, stop and relax for a few minutes.
- Keep sharp or pointed objects away from your face and eyes.
- Have your eyes checked periodically.

—from National Safety News

Pain Facts

The United States sustained fewer nonfatal injuries in the Spanish-American War (1,662 nonfatal wounds) than Army personnel sustained in maintenance, repair, and servicing work in FY 82 (2,230 nonfatal injuries). Makes a person wonder, doesn't it?

Looking at the accident reports sent in to the U.S. Army Safety Center can be a pretty grim business. The numbers become so large at times that the human, which the numbers represent, gets lost, lumped under a heading used to make the figures manageable.

Let's take a look for a minute at the heading "Personnel Injury-Other." The numbers on this one are large, and we are going to look at on-duty activities only.

"Personnel Injury-Other" involves injury to on-duty military and civilian personnel in job-related activities and off-duty military injuries. It does not include injuries caused by vehicular, fire, explosive, marine, or chemical-related activities.

In FY 82, 9,995 injuries were reported and recorded under this one heading. That number accounted for 49 fatalities and 9,946 nonfatal injuries. The cost to the Army of these 9,995

reported injuries was a whopping \$27 million; nonfatal injury costs alone came to \$23.3 million. Reported work days lost came to 122,794 or 511 years of production.

Maintenance, repair and servicing activities led in producing personnel injuries in FY 82. Most of these injuries occurred in maintenance facilities, primarily vehicle maintenance facilities. Considering this one category of activities, there were 2,239 reported injuries (9 fatalities), accounting for 23,537 work days lost at a cost of \$4.7 million.

Unsafe work practices are foolhardy any place, but doubly so in a maintenance facility. Workers misuse equipment, fail to use the required piece of equipment, lift an object improperly, don't follow the correct procedure, or they mount or dismount a piece of equipment or a vehicle without following or knowing the correct procedure. Unsafe equipment can cause a personnel injury and does when facilities are inadequate or required equipment is not available. Lack of training is another factor identified as a cause of personnel injury. Unfortunately, supervisors sometime permit workers to use the wrong procedure or tool. Oftentimes they fail to provide the protective gear or the proper equipment.

All too frequently personnel perform jobs incorrectly because they are in a hurry or overconfident of their ability. This kind of action proves the old adage that haste makes waste.

- Quitting time was 15 minutes away and the job of replacing the rear shock absorber on the tanker truck wasn't finished. Since the rubber bushing over the upper shock hanger bolt needed more pressure to force the shock and bushing into place, the worker decided a good kick would be the quickest way to accomplish the job. Using his left leg and foot as a hammer, he hauled off and kicked. He managed to pull a tendon in his lower back. A hammer and a metal pipe or adapter should have been used to do the job. The worker and the Army lost 15 work days because he was in a hurry and didn't take the time to use the proper equipment.

- The worker needed to remove the wheels and brake drum on a motorized road grader so he could replace the brake shoes. He lifted the 200-pound drums by hand rather than use the mechanical lifting device which was available. As a result, he strained a muscle in his right arm and was off work for 2 days. The report states the worker was in a hurry.

Human error becomes an accident cause factor when TMs, FM's, or SOPs are inadequate. DOD Regulation 4145.19-R-1, Storage and Materials Handling, instructs personnel never to lift beyond their own strength. However, Operator's Manual for Truck, 2 1/2-ton, TM 9-2320-209-10-4, shows one person removing a wheel from a 2 1/2-ton truck. Since this wheel weighs about 80 pounds and requires an awkward position to lift it off, chances are one individual who tried to lift it would be lifting beyond his own strength, thereby acting contrary to DOD instructions.

- The wheel and tire assembly of the P-13 fire truck had to be changed. The employee decided he could lift it by himself. He tried and suffered a ruptured blood vessel in his stomach.

- Fatigue damage caused a torsion bar on an M1 Abrams tank to shear, starting at a point where the torsion bar was splined into the right rearmost roadarm. The splined end pushed the dust protective plug and anchor out. A mechanic standing nearby was hit in the chest. Under normal conditions the M1 Abrams tank goes through an overhaul cycle after 6,000 miles of operation. However, because this was a test item, the overhaul cycle was not performed. There were no written SOPs for overhaul operations under testing conditions.

Supervisors are responsible for providing the equipment needed to do the job properly. This responsibility extends to safety or protective items as well as equipment. Lack of equipment or safety items leads to personnel error and injury.

- The service member was drilling out the drainplug for the left final drive of the M113. He was not wearing safety goggles and a metal shaving flew into his eye, injuring it. Safety goggles were not available.

- The employee was working sheet metal but was not wearing protective gloves. His hand slipped and he cut his left ring finger on an exposed edge of the metal.

- The workman was removing a radiator from a carryall truck. The radiator became caught; the workman pulled; he slipped and cut himself on a sharp edge of the radiator. He was not wearing gloves. The injury kept him off the job 6 days.

Injuries also occur to personnel who do a job incorrectly because they don't follow established procedures or because they are not properly supervised.

- Two service members were fitting a new set of track to the M60A1. The NCO supervisor was using a 10-pound sledge hammer to seat the end connectors. The second service member was

assisting by tightening the wedge bolts. The NCO swung the sledge hammer; the hammer ricocheted off the end connector and struck the assistant in the chin, causing laceration and contusion. According to TM 9-2350-215-10-3, Operator's Manual: Troubleshooting and Maintenance for Tank, Combat, Field Tracked; 105mm Gun, M60A1, the NCO should have used a 2-pound hammer to pound the end connectors. The TM spelled out the proper procedure but because it wasn't followed, 2 work days were lost and a service member suffered a painful injury.

When you detail a person to do a complicated maintenance procedure, tell them exactly what to do. Show them in the manual exactly how to do it, make sure they use the right tools, and then supervise them. Don't assume they learned the correct procedure "where they were before."

When they're moving or lifting heavy objects, demonstrate the proper stance, position, and lifting techniques before they actually lift that item.

Conduct "tailgate" sessions on a weekly basis and briefly discuss maintenance procedures around the motor pool or shop and how to reduce the safety hazards in day-to-day operations or for that particular maintenance operation of the day.

All the written procedures in TMs and unit safety SOPs won't prevent one accident unless you, the supervisor, enforce and lead by example.

Avoid making your troops a statistic by following some simple commonsense rules.

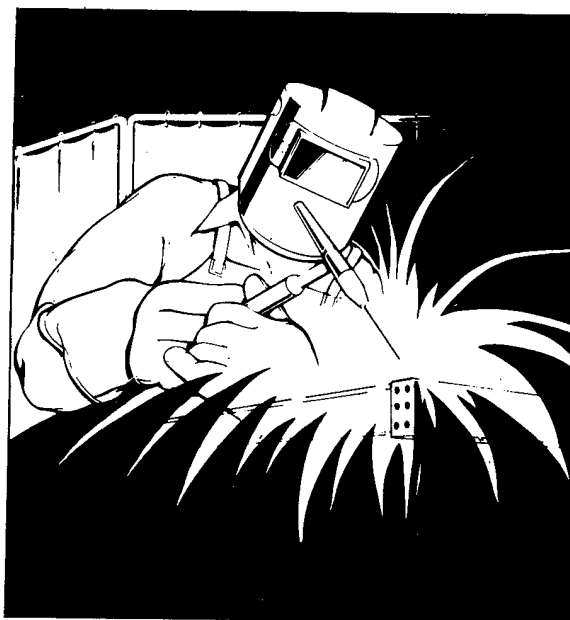
- Keep work areas clean and tools in place.
- Demand compliance with established work procedures no matter how routine the task.
- Require the use of the right tool for every job.
- Make sure protective equipment is available and **worn** on the job.
- Supervise. Check work areas. Look for unsafe conditions, unsafe acts, and unsafe procedures. The quality of supervision makes the difference.

Welding Incident

Earlier this year, a hangar fire at Moore Army Airfield at Fort Devens, MA, cost the government \$570. The fire was the result of a minor welding/brazing operation to secure hinge pins on a personnel door for security. The heat from the welding torch caused a "hot spot" which stayed hot enough, long enough to ignite the insulation in the wall next to the door. "Hot spots" have been known to hold sufficient heat for ignition for as long as 20 minutes, plenty of time to ignite the cellulose insulation.

The fire only consumed a small portion of interior wall insulation, and its resulting costs were minor. The **potential** costs, however, might have reached **several million dollars** in aircraft and buildings. The time of day played an important part in this incident, since the brazing was done in the morning and the fire discovered before noon. If the work had been completed at the end of normal duty hours, the results would probably have been different.

The welders observed all Army, FORSCOM, and Fort Devens welding safety regulations. However, an incident did occur. Possibly, if in addition to waiting the required 20 minutes to check for fire, the welder had cooled the door with a damp rag, the "hot spot" might not have ignited the insulation. "Hindsight," of course, is nearly always 20-20. Nonetheless, we bring this to your attention to emphasize that one can never be too vigilant.



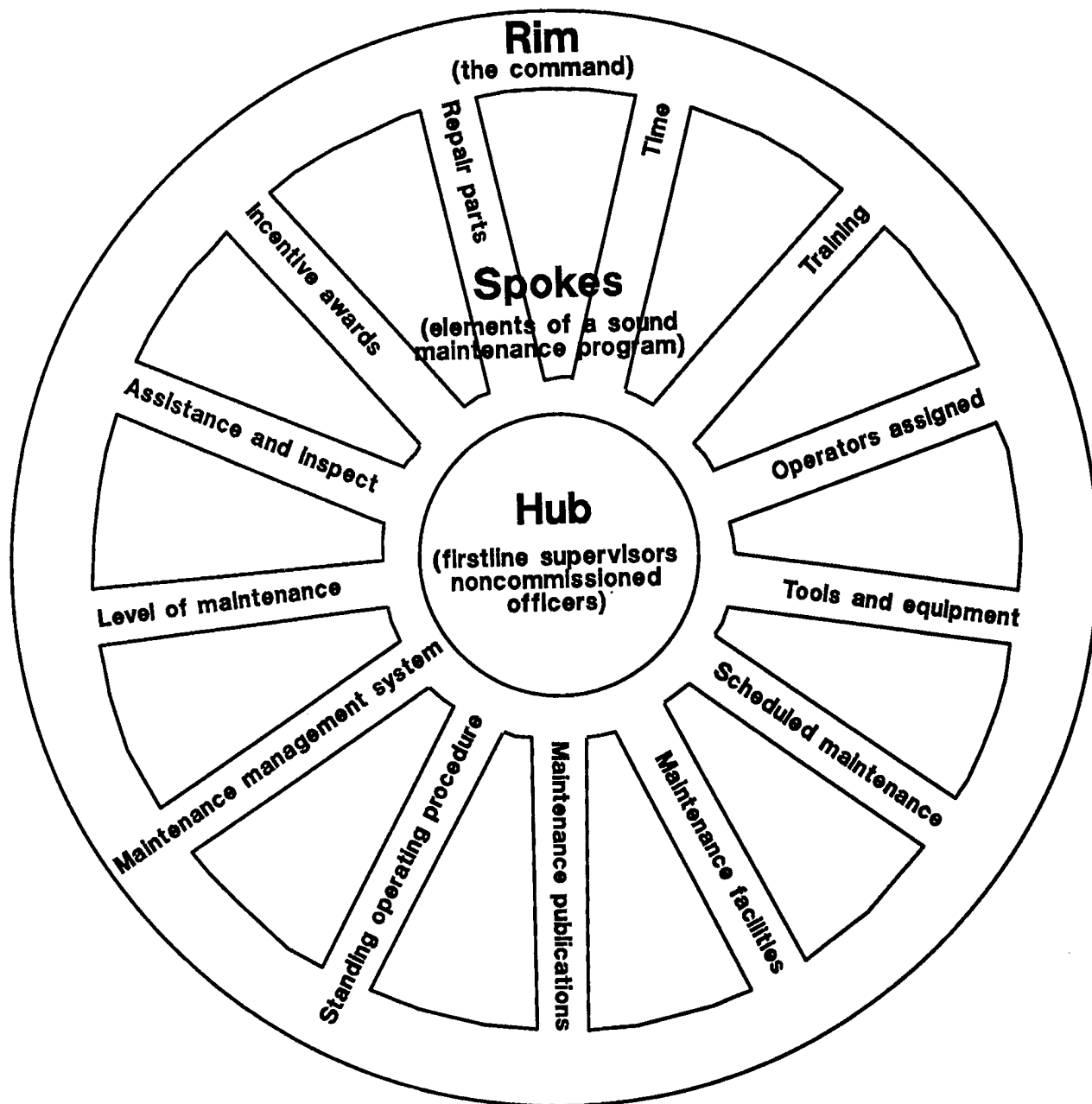
Maintenance—A Combat Multiplier

Maintenance is critical to our wartime survival. With the expected intensity and lethality of

the envisioned battlefield, survival will depend, in part, on an efficient and responsive maintenance program. A sound maintenance program will be an advantage—our combat multiplier. What is a sound maintenance program? Many commanders can easily list some elements, but few can outline how these elements fit together to form an effective maintenance program.

An effective maintenance program revolves around its elements and their interaction. To illustrate the elements of a sound maintenance program, a "maintenance wheel" is used to show how elements must interrelate. The three major elements correspond to the wheel's hub, spokes, and rim. Effectively integrating these elements into a coordinated program can keep equipment rolling. Let's examine each of the three elements.

Hub. The firstline supervisors form the all-important hub of the maintenance wheel. They are the catalytic force of the maintenance program—its leaders and trainers. They are the principal directors of the program, ensuring that the available maintenance resources (the spokes) interact properly for smooth operations. Without their positive support and active



participation, an organization's maintenance program would be disjointed and would fail to function.

Many of these firstline supervisors are junior noncommissioned officers (NCOs). Their first measure of effectiveness is how well they and their subordinates maintain their assigned equipment. They are responsible for effectively using their resources to support the maintenance efforts. The NCO's responsibility for maintenance is explicitly outlined in FM 22-600-20, The Army NCO Guide. He is responsible for the individual training of soldiers in their MOSs and in basic soldiering skills. He must train soldiers to employ, maintain, and care for the weapons, combat vehicles, and equipment with which they do their jobs. He must also assume responsibility for the maintenance, serviceability, accountability, and readiness of arms, clothing, vehicles, and equipment.

Supervisors must be aware of the influence they wield. Organizational studies document that the amount of consideration shown by a supervisor is positively related to work unit efficiency. A good maintenance program, therefore, develops around a responsible firstline supervisor. He should be given the responsibility for the materiel readiness of the organization's equipment, provided the authority to carry out this awesome task, and then held accountable for its readiness condition.

Many firstline supervisors want to subordinate their maintenance responsibility to what they view as their responsibilities as a soldier and a technical specialist. But without operable equipment, today's soldier cannot perform his mission and will not be able to fight or support the fighting soldier. Maintenance and training are two tasks that cannot be subordinated or separated from mission accomplishment. General Edward C. Meyer described maintenance and training as "the two balls that the juggler can never drop."

The supervisory hub is the center of the wheel and forms the core of the organization and its maintenance program. The hub brings the spokes (maintenance resources) together and ensures smooth interaction. It is the driving component that powers and controls the direction of the spokes and the way the wheel goes.

Spokes. The second element of the wheel is its 13 spokes. They provide the support and shape of the wheel. The spoke "names" are self-explanatory and a detailed description of each is not necessary, but some elaboration of the importance of each to a sound maintenance program is appropriate—

- Time is perhaps the most critical available resource. Adequate time must be set aside to perform operator and organizational maintenance. This time should be useful and productive.
- Training in maintenance must have the same emphasis that is given to unit training in military occupational specialties. The quality of maintenance training will determine whether or not the unit's equipment will be available to accomplish its mission. Full advantage must be taken of both formal schooling and training that can be accomplished within the organization.
- Operators must be assigned to each piece of equipment and must be responsible for the care of that equipment. Operators must be able to perform preventive maintenance checks and services and must be present for all scheduled maintenance periods. Trained operators can prevent many equipment failures, and inexperienced operators can nullify all the efforts to properly maintain equipment.
- Tools and test, measurement, and diagnostic equipment of the right kind must be available and must be used. Unit personnel must be knowledgeable in the use of all tools necessary to perform their level of maintenance.
- Scheduled maintenance periods, just like scheduled training periods, are necessary. The Joint Chiefs of Staff recognized the importance of scheduled maintenance in specifying that a program of preventive maintenance would be established by all services.
- Facilities and an adequate work area must be provided. To the extent possible, the maintenance area must be covered, safe, and clean. Military maintenance personnel are often forced to work under adverse conditions. These conditions can be improved through self-help programs and the continuous indoctrination that maintenance operations must be done the same way in peacetime as they are in wartime.
- Publications and technical manuals and their appropriate use save time and help identify proper maintenance procedures. A good library, to include current operator manuals for each individual piece of equipment, is both a service and a training aid; however, the manuals must be

used. The failure to use manuals and lubrication orders can be disastrous and may result not only in damaged equipment but possible injury or death.

- Standing operating procedures (SOPs) must spell out maintenance procedures for supervisors at all levels and provide a means of improving the cost-effectiveness of military maintenance.

- Maintenance management system planning must ensure that the maintenance mission supports the unit's mission. This system should include the organization's maintenance SOP, a means to forecast and plan for scheduled operation, use of quality controls, methods of reporting to higher headquarters, procedures for maintaining current records and files, and submissions of historical reports.

- Higher level maintenance requirements must be taught. Unauthorized maintenance may result in costly, inadvertent damage to equipment and create major problems for the supporting maintenance units. Organizations must be taught not to perform maintenance beyond their authorized level. The organization and its supporting maintenance units must work as a team to achieve the highest equipment operational readiness rates. Support activities are a valuable means of assistance; but it must be remembered that cooperation and coordination is a two-way street.

- Assistance and inspection reports are a means to measure the maintenance program's effectiveness. Additionally, the use of assistance teams to help in areas where internal expertise is not available should be encouraged. Organizations should look forward to inspections as a way to validate their programs. Inspections should be thought of as an aid, not a detractor.

- Incentive awards for effective maintenance efforts cannot be overemphasized. Good maintenance practices must be rewarded and poor practices corrected. Incentive awards must be publicly presented to positively motivate personnel. Corrective actions, by the same token, need to be publicized.

- Repair parts lists and prescribed load lists, representing demand-supported and command-directed items, must be accurate. Reconciliations, followup actions, and supply discipline must be continually exercised. Additionally, repair parts received must be applied to equipment as soon as possible. Alternative supply sources must be investigated when necessary.

All 13 spokes are important to a maintenance program "wheel"—any weak spoke can have an adverse effect on the organization's maintenance efforts. Many of the spokes are both dependent upon and complementary to each other. This interaction can lead to one spoke counteracting the weakness of another; but over a period of time, the stress may be too much and the spoke will break.

The spokes, while providing support for the maintenance wheel, are not the most critical component. The two most crucial components are the hub and the rim of the wheel. Weakness at either can cause the wheel (maintenance program) to slow; their breakage can cause it to stop.

Rim. Surrounding the hub and the spokes is the rim, representing, in my example, the command section. This section is responsible for planning, organizing, staffing, directing, and controlling all operations of the organization. Management and its functions extend to the maintenance efforts. One of the most important incentives to a successful maintenance program, according to former Secretary of the Army Clifford L. Alexander, Jr., is "the personal manifestation of maintenance consciousness by the commander" through his personal interest, attention, and involvement. Without the total conscious backing of the command section, the maintenance program—like the wheel—would continue to roll roughly for a while but would eventually break apart.

The top priority of the Department of the Army maintenance management improvement program, according to former Deputy Chief of Staff for Logistics Lieutenant General Arthur J. Gregg, was to "focus command attention on maintenance and assure that it receives a balanced share of the commanders' time and emphasis." Yet, the command section, when performing its management functions, must avoid such "eyewash" maintenance as clean, newly painted vehicles, but with no gas and dry batteries. The most frequently mentioned detractors to a sound maintenance program found in the 1977 Perceptions Maintenance Study were—

- Working under arbitrary and unrealistically imposed work schedules.
- Doing "busy work."
- Maintenance personnel being kept on duty when there was nothing to do or being called in

from scheduled off-duty time to work. "Eyewash" maintenance and these detractors are under the control and authority of the command section. To have harmony and balance in the maintenance system, it is imperative that responsibilities of each organizational level be defined and kept in perspective. This means that standards be established for subordinate supervisors and that checks be created to ensure that supervisors perform to those standards.

Decentralization and trust in the lower echelons must filter down from the top. The commander controls the availability of all maintenance resources (including the most precious resource—time) through his supervisors. The command section—the rim—provides the shape the maintenance wheel will take and provides the resources on which the "wheel" will roll.

A sound maintenance program comprises three essential components: maintenance resources, supervisory personnel, and a command element. The "maintenance wheel" model provides a basis for understanding the maintenance components and how they interact with, and complement, each other. The wheel is an applicable model for any size unit, from platoon to corps. For maintenance to be a combat multiplier, the wheel must roll!

—from Army Logistician

Lock-Ring's a Killer

You can never tell exactly what'll happen when you put a tire, rim, and lock-ring together and then shoot the air to it. If all goes well, the parts seat. Air pressure holds 'em together. They'll stay that way until you take 'em apart again.

But sometimes all does not go well! The lock-ring can fly off the rim while you're building pressure in the tire. If it hits you, it can kill you! The tire can explode—and blast you with the concussion of a bomb!

You can't trust it until the tire's been inflated to normal pressure—and nothing bad has happened.

So—to save your own neck—always use a tire inflation safety cage and always stand at least 10 feet away from the tire while inflating it.

To inflate the tire from a safe distance, you need to add an extension to the 25-foot air hose, NSN 4720-00-356-8557, in your No. 1 Common Shop Set.

Get inflator-gage, pneumatic tire, NSN 4910-00-441-8685. This is a gage-and-hose about 10 feet long. It comes with a quick-disconnect coupler and two coupler adapters—regular size for most automotive tires and a larger size for some construction equipment tires.

To connect the 25-foot hose to the gage, use adapter, straight, pipe-to-tube, NSN 4730-00-391-3771. You get six of these adapters in the tube-pipe fitting kit, NSN 4730-00-470-6625, in your No. 1 Common Shop Set.

When you've got your tire and rim assembly in your cage, screw the right size coupler adapter onto the tire valve. Attach the extension hose by pushing the quick-disconnect coupler onto the adapter.

Back off to the full length of the extension hose and inflate the tire.

—from PS Magazine

Improper Use of Cotter Pin Breeds Trouble

"A little neglect may breed mischief: for want of a nail the shoe was lost; for want of a shoe the horse was lost; and for want of a horse the rider was lost."

Benjamin Franklin wasn't writing of cotter pins when he wrote the above maxim for *Poor Richard's Almanac*, but the philosophy sure applies. Let's take a look at just a few examples.

- The driver and two passengers were en route to the motor pool in an M151 1/4-ton truck when the wheel came off. One passenger was injured. The **cotter pin** had been left off during some previous removal of the wheel bearing assembly which allowed the nut to vibrate or twist off, and then the wheel came off.

- There was no apparent reason for what happened! He was driving along the highway, lost control of his vehicle, and the vehicle flipped on its left side. The driver was thrown from the

vehicle and the two passengers were pinned under it.

On-scene investigation showed the left rear wheel came off. A further maintenance check found that the **cotter pin** had not been put in the left rear spindle. The main hub nut loosened and fell off the spindle, causing the wheels to come off.

• An M151A2 was traveling west with the driver and two passengers. The right rear wheel came off the vehicle. A passenger was thrown from the vehicle and landed on the blacktop roadway, sustaining minor bruises. The vehicle traveled 55 feet, crossed the center line to the left side of the roadway, and continued on another 358 feet before the driver was able to stop it by downshifting and using the hand brake. Investigation showed that the **cotter pin** was not installed in the right rear wheel, and the left rear wheel **cotter pin** was not spread open to prevent it from coming out.

The above problem is probably a common maintenance deficiency. During FY 81-83, 18 accidents were reported for loss of wheels because mechanics reused old cotter pins or did not install a cotter pin. Clear instructions are given mechanics in TM 9-2320-218-20-1-2, par 9-5b, step 5g, to use a new cotter pin to secure the wheel bearing adjusting nut.

The 18 reported accidents—for want of a cotter pin—cost the Army \$54,925 in injury cost, \$82,085 in damage cost, for a total cost of \$137,010.

All this loss in money, time, and suffering could have been avoided if only a cotter pin had been used. The amazing thing is: cotter pins cost 35 cents per 100!

Use Steel Hydraulic Brake Lines

Hydraulic brake lines on tactical wheeled vehicles are made of steel. The replacement brake line better be of steel, too.

Seems some units are replacing the steel hydraulic brake lines with the copper tubing used for the air lines of the same or similar tactical wheeled vehicles.

Copper tubing may be more available and easier to bend, but it won't do the job that needs to be done on the brake lines. Copper tubing brake lines will rupture at pressures well below hydraulic system pressure, fluid will be lost, then there will be a complete loss of brakes.

Stainless steel replacement tubing has to be ordered through the supply chain by designated stock number. Fittings are already attached so it is less work to replace a brake line with the proper part than with copper tubing. It is a whole lot safer, too.

TACOM message, dated 5 August 1983, states: "Any tactical wheeled vehicle found with copper tubing being used for hydraulic brake lines will be classified not mission capable (NMC) until brake lines are replaced with authorized steel tubing."

Take time to check the brake lines on your vehicle. It could save your life.

Army Motor Vehicle Brake Failures

General Maxwell R. Thurman, Vice Chief of Staff Army (VCSA), was briefed by the Tank and Automotive Command (TACOM) on Army motor vehicle brake failures at the September in-process review of Army safety. The briefing resulted in the VCSA directing TACOM and the Army Safety Center to undertake a safety campaign for ground vehicles.

The VCSA directed that the number of brake-related accidents be reduced to 1 percent of the total number of Army accidents for tactical vehicles, except 2 1/2-ton and 5-ton trucks. For 2 1/2-ton and 5-ton trucks, he directed that Class A accidents resulting from brake system failures be reduced by 50 percent.

To maintain brake safety in the older fleet of trucks, increased attention to high quality maintenance is a first priority. Meticulous maintenance must be performed at all levels with special emphasis on drivers' preventive maintenance checks and services (PMCS). Thorough periodic maintenance together with supervised PMCS will go a long way toward accomplishing the mandated 50 percent reduction in Class A accidents resulting from brake system failures in 2 1/2-ton and 5-ton trucks.

Minimum vehicle safety standards are listed in AR 385-55, Prevention of Motor Vehicle Accidents. A stronger, revised AR is now being coordinated with the MACOMs. However, the present AR clearly states that vehicles will not be operated with "improper functioning or

adjustment of brakes." TMs state that equipment is not ready or available if "service brakes do not operate properly." There is a clear requirement that vehicles will not be operated with defective brakes. When vehicles with defective brakes are moved for maintenance, they must be towed. Further, maintenance personnel should physically **red tag** vehicles with defective brakes.

Commanders are responsible for selecting, testing, and licensing Army motor vehicle drivers. They are also responsible for ensuring that drivers are properly trained. A rewritten AR 600-55, Motor Vehicle Driver Selection, Testing, and Licensing, soon to be fielded, has a chapter devoted to driver's training that should help. Driver's training classes must include and emphasize brake system operations and the safety-critical importance of PMCS.

TACOM policy prohibits the repair of brake wheel and master cylinders on tactical vehicles. TACOM found that rebuilt wheel cylinders had a high rate of failure and were implicated in brake-related accidents. So, defective brake wheel and master cylinders on tactical vehicles should be thrown away. Replace them with new ones. Repair of these same cylinders on other vehicles and equipment can be done by following the guidance in the appropriate technical manuals. Remember, use new brake wheel and master cylinders on tactical vehicles.

Stop Brake Failures

Faulty brakes are a frequent cause of Army motor vehicle accidents, especially in 2 1/2-ton and 5-ton trucks. Brake system failure is the largest—maybe even the single greatest—cause of maintenance-induced AMV accidents.

Army vehicle drivers are responsible for keeping their vehicle in safe operating condition and for maintaining its mechanical efficiency. They are the most important single factor in preventive maintenance. Established preventive maintenance checks and services (PMCS) done regularly and thoroughly are the driver's means of ensuring a safe, efficient vehicle.

During the daily maintenance inspection, drivers should pay extra attention to the brake system and check it carefully.

Most brake accidents are caused by failures of brake lines, air hydraulic cylinders, parking brakes, wheel cylinders, and master cylinders. Both drivers and maintenance personnel must pay close attention to these components.

In addition to operating the service brake to determine stopping ability and to setting the hand brake to determine the parking brake's ability to hold the vehicle, the driver should check brake hoses and brake lines. This can be done when looking for evidence of fluid leakage. If a brake hose is stretched, bent, or cracked, it should be replaced. Any brake line that is leaking or damaged should be reported to Organizational Maintenance so they can replace it. If there is a loose fitting or connector, it should be tightened.

The driver should check the inside area of all four wheels to be sure there are no fluid leaks from the wheel brake cylinders. He can check the hydraulic brake fluid in the master cylinder if he finds the brake pedal sinks too close to the floorboard. To do this, he will need to open the master cylinder, located on the driver's side of the cab floor, and use a flashlight to see into the master cylinder reservoir to check the fluid level. Lack of fluid in the master cylinder is a frequent cause of brake system failure accidents.

Vehicles are not to be operated with defective brakes. When brakes do not function properly, the driver should leave the vehicle in place and notify Organizational Maintenance. Maintenance personnel should deadline and physically attach a red tag on any vehicle with defective brakes. When they move the vehicle with defective brakes for maintenance, that vehicle must be towed using an approved tow bar.

Brake failure accidents can be reduced greatly by the following actions:

- Make it unit policy that preoperational checks—with special emphasis and attention on brake systems—be performed by the driver before accepting any vehicle.
- Hold drivers responsible for making these preoperational checks.
- Have first-line supervisors enforce and supervise the driver's preoperational checks.
- Require drivers to check master cylinder and the inside area of all four wheels to be sure there are no fluid leaks.
- Have drivers start their vehicle, let it move forward about 3 feet, and try the brakes once again. Make sure the brakes hold.

- Require your mechanics to pay special attention to brake systems during periodic maintenance inspections. Have them carefully check brake lines and air hydraulic systems on vehicles for cracks or fractures.

Periodic maintenance, together with the requirement for supervised preoperational brake checks by drivers, is the cure for accidents caused by faulty brake systems.

M151s Need Correct Wheel Cylinders

The use of incorrect wheel (brake) cylinders on 1/4-ton series vehicles sets up a potentially dangerous situation.

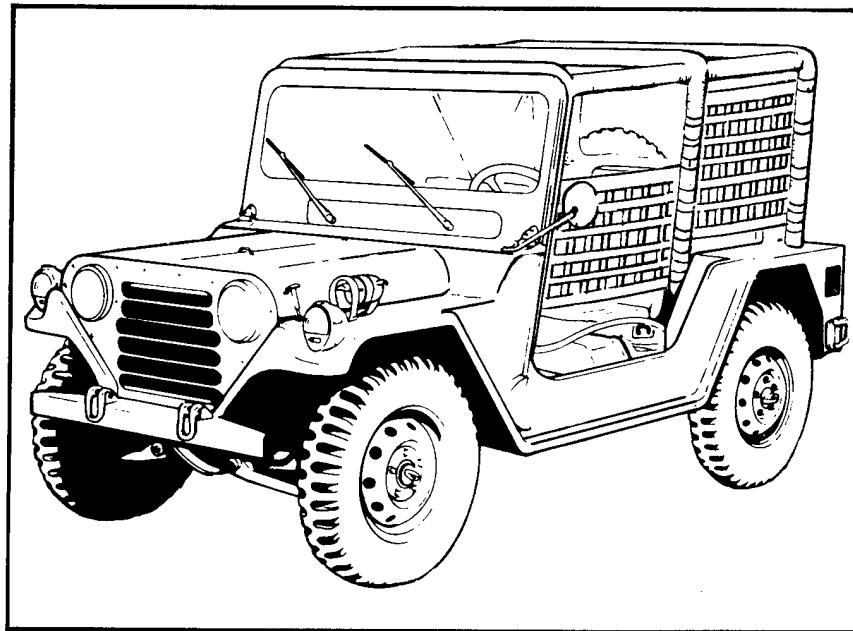
There are two 1/4-ton wheel (brake) cylinders in the supply system. These cylinders are .750 (3/4) inch and 1.00 inch internally measured. Both of these cylinders are identical except for piston size. These wheel cylinders have been installed mismatched as to designated location and size of diameter.

Service brakes, when properly installed and adjusted and with preventive maintenance performed, will stop the 1/4-ton vehicle within 30 feet (9.15m) at a speed of 20 mph (32.18 km/h) on a dry, hard, relatively level, smooth surface when the brakes are applied. Incorrect or mismatched cylinders may cause unequal braking or insufficient stopping ability.

The large cylinder (1.00 inch) is for installing the front wheels of the 1/4-ton A2 series. The part number and stock number of this cylinder are: 1.00-inch cylinder—PN 11669159, NSN 2530-01-071-9850. The part number is on the wheel cylinder casing. A decal with a **green** background and white lettering is attached to the 1.00-inch cylinder and states that this cylinder is to be used on the front axle of the M151A2 series only.

The smaller cylinder (.750 inch) is for use on the rear wheels of the 1/4-ton A2 series and for all wheels on the 1/4-ton A1 series. The part number and stock number of the smaller cylinder are: .750-inch cylinder—PN 11669158, NSN 2530-01-071-9851. The part number is on the wheel casing. The decal attached to the .750-inch cylinder has a **blue** background with white lettering. The decal states the .075-inch cylinder is to be used on the rear axle of the M151A2 and on the front and rear axles of all M151A1 series vehicles.

The next change to TM 9-2320-218-20-1-2 and TM 9-2320-218-34-1 will have the information on the distinctive markings of the two cylinders. The same change to the TMs requires that all four wheels on the M151 series be removed and that brake components be inspected during the semiannual preventive maintenance checks and services. Wheel cylinders are to be inspected for leaks and for proper size.



Remember the QDR/EIR

The QDR (quality deficiency report) or the EIR (equipment improvement recommendation) is a little report that accomplishes a lot. Any person who discovers a deficiency in an item should get an SF 368, fill it in completely, and mail it in.

Too often the reason you must live with a problem so long is that no one bothers to submit a QDR/EIR. Don't wait for someone else to do it for you. If a deficiency in equipment is not known,

a solution cannot be obtained. Use the SF 368.

If an SF 368 is sent as the result of an accident, or is safety related, include the QDR/EIR number in block 33 of DA Form 285, U.S. Army Accident Investigation Report.

Head off M939-Series Wheel Lockup

Head off possible steering wheel lockup on your M939-series 5-ton truck.

After activating the self-canceling turn signal on the M939-series 5-ton truck, you make your turn, try to straighten out, and you can't. That's when the cancellation pin locks your steering. The high spring tension causes the pin to be wedged against the steering shaft. This can put you in a continuous turn—a sure path to trouble.

To correct this problem, get your mechanic to take the pin and spring out of the turn signal self-canceling assembly—item 2 on page 5-139 of TM 9-2320-272-20-1. The mechanic may need to lower the control on the steering column to lift the cover. The control will no longer be self-canceling control, but it'll be safer. If you need a control, don't order the self-canceling control, NSN 6220-01-089-3049 in TM 9-2320-272-20P. Instead, get NSN 6220-00-808-6072. It's not self-canceling and it's a lot cheaper. It's got to be mounted below the canceling pin—item 3 on page 5-139 in the -20-1 TM.

—adapted from PS Magazine

AMV Brake Maintenance Can Be Health Hazard

The last time one of your AMV mechanics used an air hose to blow out a brake drum, he sent a cloud of asbestos fibers freewheeling through the air and probably right into someone's lungs.

Remember that gray-black powder that fell on the floor when he pulled the brake down? That contained asbestos fibers which are dangerous when inhaled into the lungs.

Some of our vehicle maintenance manuals have no caution or warning about these asbestos hazards, but they should—and will as soon as the changes are published.

Asbestos has been found to produce severe lung damage in the form of disabling or fatal fibrosis of the lung, termed asbestosis. It has also been found to be a factor in the development of lung cancer and is suspected of contributing to cancer of the gastrointestinal tract. The effects of asbestos exposure are not immediate, but can show up 20 to 30 years after the first exposure.

When a mechanic is servicing or replacing components containing asbestos, the "wet method," simply soaking the components before handling them, is the preferable procedure to use. Wetting the components reduces the risk of exposure to airborne concentrations of asbestos. Keep in mind that wetting the components keeps the airborne concentrations of asbestos within the OSHA permissible exposure limits.

If it's not possible to use the wet method to prevent exposure to airborne concentrations of asbestos, personnel should use approved respiratory protection in accordance with TB MED 502.

It's also possible to be exposed to unacceptable airborne concentrations when sweeping dry dust or when dumping a trash can containing asbestos dust, so use respiratory protection for those jobs, too.

References

- OSHA Standards 29 CFR 1910.1001
- DA Cir 40-83-4
- TB MED 502
- Public Law 91-604
- AR 40-5

A Respirator Program That Works

Each day, several hundred Army employees depend upon respirators to protect them from toxic contaminants in the workplace. They are painters, welders, pesticide applicators, and others who must wear some type of respirator to protect themselves from harmful vapors, fumes, or

particles in the air. While it is Army policy to control occupational hazards by engineering means, it is not always feasible to do this, and other methods of protection must be used.

Respiratory protection for the Army workforce is expensive. Respirators range in price from about \$14 to over \$600. They are normally used for a period of useful service and thrown away. The Army is proposing a new system to recycle respirators and restore them to useful condition.

Actually, a new regulation that has been out for review (AR 11-XX) will require, not just propose, recycling of respirators. There were a lot of screams heard from the first review. LTC Ron Bishop at the Army Surgeon General's Office says that a forthcoming revised draft incorporates several changes and clarifies several points that were not understood. The intent of AR 11-XX is to establish an Army respiratory protection program similar to one in use at the Anniston Army Depot, Anniston, Alabama, which was recently evaluated by the U.S. Army Safety Center.

Several years ago, the depot was cited by OSHA for unsafe working conditions. One of the conditions cited involved issuing respirators without checking the fit. This was one of the primary factors that brought their present program into existence.

The depot's respirator program has been in effect for a couple of years now. The program has proven to be functional and efficient, and it produces a large dollar savings over the costs for respirator protection before the program.

The respiratory protection program function is located within Anniston's Administrative and Services Directorate. The Respiratory and Safety Equipment Section stocks and issues not only respirators but all other safety equipment used at the depot except prescription safety glasses and safety shoes. It is a one-stop store which saves employees a lot of time. When they are initially issued respirators, employees are trained in the use of and requirements for respirators. They are given both a qualitative and a quantitative fit test. Fit-testing is done on an annual basis after that.

Only the respirator specialist is authorized to purchase and issue respirators. The industrial hygienist provides guidance on the type of respirator needed in each work area. This assures that each employee receives the proper type. Used respirators are turned in to the Respiratory and Safety Equipment Section where they are cleaned, rebuilt, and reissued.

Gerald Price, chief of the section, says that when the respirators are reassembled with new parts and new filters, they will be as good as or better than new masks. Price also proudly points out that his program saved the depot over \$150,000 in fiscal 1984, and he has the figures to prove it! This saving is after calculating the salaries of five people and the cost of repair parts.

These days, we can sure use a program like that.

600-Gallon Portable Fuel Pods Present Possible Hazard

A potential safety hazard was identified during a recent review of accidents involving fuel pods. In some units, personnel frequently get inside the 600-gallon portable fuel pod to clean or empty it. This is a dangerous practice that can lead to loss of consciousness or even death. In one accident, the rescuer who entered the pod to retrieve an unconscious victim quickly became a second victim of the mogas vapors.

The manuals for portable fuel tanks contain instructions for cleaning and purging. These procedures are to be done from **outside** the tank using water and a purger or detergent solution. Conduct a combustible vapor test reading using an explosive meter, prior to and immediately after purging. Only competent personnel, thoroughly instructed in the proper handling and reading of the explosive meter, will conduct vapor tests. When it does become necessary for someone to get inside, for example, to perform repairs, the tank should be purged completely beforehand. The person who is to enter the tank should have a safety line attached, and a second person should remain at the manhole to observe and to pull the other out if necessary. This restriction should also be added to the unit SOP.

Until the hazard can be evaluated and resolved by the responsible agencies, commanders are urged to inform maintenance personnel working on fuel pods of the hazard and to exercise caution when it becomes necessary to enter the fuel pod.

Any remarks on similar circumstances concerning fuel pods are encouraged.

References

- TM 5-4930-230-12, Operator and Organizational Maintenance Manual, Tank Unit, 600-Gallon Liquid Dispensing, for Trailer Mounting.
- TM 5-4930-230-13, Operator's Organizational and Direct Support Maintenance Manual.

Study of Maintenance Accidents in Wheeled and Tracked Vehicle Facilities

The U.S. Army Safety Center recently analyzed selected Army maintenance accidents that occurred in wheeled and tracked vehicle facilities. These selected maintenance accidents involved on-duty soldiers and civilians injured while installing, removing, or modifying equipment in these facilities. The study of these accidents identifies 11 problem areas which account for the majority of the accidents. It also reveals that four primary cause factors are regenerating most of the accidents. In addition, the study shows that—

- Most of the injuries involve tactical Army motor vehicle maintenance. (There are more of these vehicles in the Army inventory than other types.)
- The user or organizational level of maintenance has the most injuries. (This is the level at which most maintenance manhours are expended.)

Problem areas

1. Improper use of tools and equipment. Included in this area are the following specific items:

- Improper use of jacks, hoists, and lifts causes loads to shift and fall. Maintenance personnel are not using the correct jack, hoist, or lift, are not load-testing devices that require it before use, and they are not properly inspecting load security before and during operation.
- Protective equipment—safety goggles, gloves, shoes, and helmets—can do its job only if it is used. Too often protective equipment is not worn because the maintenance person is in a hurry, doesn't see the need to wear it, or doesn't know it should be worn. Supervisors often do not ensure the equipment is available, or they knowingly allow maintenance personnel to perform tasks without wearing it.
- Hammers are improperly used so that the head does not strike the intended target; hammers are used instead of the proper tool; or the wrong type hammer is used. Poor hammer strikes cause back strain, lacerations, contusions, and hand or head fractures. Using the wrong hammer for a job can cause it to bounce off the equipment and cause injury.
- Pliers used as clamps allow the load to fall and crush a finger. Personnel use standard pliers for tasks that require brake-spring pliers, and the pliers slip or the brake spring recoils, causing injury.
- Personnel use the wrong size or type of wrench or socket for their task. Even when they have the correct wrench or socket, they use it incorrectly (e.g., tool is not properly seated or fitted; rusted or tightly torqued nuts or bolts are loosened incorrectly; unauthorized extensions are added to handles for additional leverage). Using the wrong wrench or socket or using it incorrectly can result in it slipping or breaking, causing injuries. Overexertion can also result in and cause strained torso muscles.
- Screwdrivers are used as levers. Metal chips and particles break off and hit the user in the eye.

2. Improper lifting. Personnel lift repair parts, wheel assemblies, or other materiel incorrectly or fail to use appropriate assistance to do the task. Overexertion results in back, arm, and abdominal injuries. Shifting or falling parts and components cause face, hand, and leg injuries.

These two problem areas make up 61 percent of the maintenance accidents.

3. Improper body position. Personnel put themselves in hazardous positions or assume a body position that causes injury. Unstable and hazardous body positions result in falls, back and limb injuries, fractures, and burns.

4. Inadequate security of components or equipment. Personnel do not secure or do not properly secure components, equipment, or vehicles before moving them. Injuries to back and extremities result when these items shift.

5. Improper pulling, gripping, or holding equipment or components. Personnel pull too hard on tools or parts, do not grasp parts firmly, attempt to hold slippery components, etc. Muscle strains and falls are the primary injuries in this problem area.

6. Inadequate inspection. Personnel fail to verify that parts are in proper location and to detect jagged edges, defective parts, need for special lubrication, and dangerous work surfaces. Inadequate inspection of components, equipment, or work areas leads to hand injuries, burns, bruises, and falls.

7. Inadequate communication. Personnel fail to warn co-workers when they start a vehicle or move/operate equipment, and they fail to tell others of inoperable components or equipment.

8. Failure to depressurize or disconnect components or equipment. Maintenance personnel do not release pressure on hydraulic fluid, or they do not disconnect battery terminals before removing the battery.

9. Inadequate improvising. Personnel use their hands or feet instead of mechanical assistance.

10. Obstructed/cluttered work areas. Personnel do not clear the work area before beginning work, or they lay components or tools down during a maintenance task and then stumble into or over them.

11. Materiel failures. When written procedures are inadequate for tool use or materiel is inadequately manufactured, materiel failure occurs.

Cause factors

1. Inadequate self-discipline is the most frequent cause of accidents during installation, removal, and modification tasks. Overconfidence, inattention, and haste are often involved. Personnel may knowingly fail to use proper procedures because they do not understand the reasons for the rules and the potential for injury or because of a lack of supervision.

2. Inadequate supervision results when leaders permit the use of unsafe or incorrect procedures or fail to closely monitor personnel. Insufficient command emphasis on safety permits supervisors to allow shortcuts. Supervisors are not monitored to ensure they fulfill their responsibilities. Also, corrective action is not taken by higher command when supervision breaks down.

3. Inadequate written procedures show up in the lack of standing operating procedures (SOP) and in vehicle technical manuals. Inadequacies consist mainly of absent or incomplete procedures for certain maintenance tasks. SOPs are not periodically reviewed to keep them current. Failure to submit DA Form 2028, Recommended Changes to Publications, permits deficiencies in vehicle technical manuals to remain.

4. Inadequate unit training results in personnel being assigned tasks for which they either are not trained or have received insufficient training. This occurs when supervisors do not properly assess training needs and develop and conduct training programs. Insufficient command emphasis on and monitoring of training furthers this problem.

Recommendations

- Hold personnel accountable for safe conduct on the job.
- Include standards on safe performance in civilian employee performance appraisals for both employees and supervisors.
- Include evaluation of safe performance in Enlisted Evaluation Reports and Officer Efficiency Reports for subordinates and supervisors.
- Spell out in unit SOP requirements for use and type of personal protective equipment.
- Review all maintenance manuals to ensure guidance and instructions for tasks involving installation, removal, and modification of components are explicit and complete. Manuals should include tools for all tasks, designate necessary personal protective equipment, and include appropriate warnings or cautions. Submit DA Form 2028 to suggest improvements or to highlight deficiencies in manuals.
- Include in maintenance programs instruction in hand-tool safety, use of protective equipment, and proper lifting procedures.
- Ensure SOPs adequately describe methods to be followed and cover safety aspects of all activities.
- Ensure supervisors at all levels regularly conduct unscheduled spot checks to be sure

personnel are using correct, safe operating procedures.

- Increase use of incentive awards to recognize sustained safe performance and consistent use of proper procedures.
- Publicize safety achievements.

MEK Corrodes M939 Airbrake System

Methyl ethyl ketone (MEK) **cannot replace** methyl alcohol (methanol). MEK has been found in the airbrake systems of some M939 5-ton trucks. Maintenance personnel believe that MEK was substituted for methyl alcohol.

MEK damages the rubber and plastic components of the airbrake system. This damage could cause a high concentration of fumes in the cab of the M939.

If MEK is in an M939 airbrake system, simply purging the system will not repair the damage that has already been done. To correct the problem, TACOM recommends the following procedures for a one-time inspection:

- Contact the local environmental hygienist and run a parts-per-million (PPM) evaluation on the cabs of all M939 series vehicles suspected of MEK contamination. Unacceptable levels are 260 milligrams per meter cubed for a 40-hour work exposure and 310 milligrams per meter cubed for short-term exposure. Methanol exposure should be limited to 15 minutes no more than 4 times per day.

- If the PPM check shows a vehicle has an unacceptable level of fumes in the cab, replace all rubber and plastic components of the airbrake system. Then run another PPM check before putting the truck back into service.

- When M939 checks are completed, send TACOM the serial numbers of any trucks contaminated by MEK, the estimated time they will be deadlined awaiting parts, and the current status of trucks not affected. Send this information to Commander, TACOM, ATTN: AMSTA-MTB, Warren, MI 48397-5000, AUTOVON 786-8275.

Carbon Monoxide Is Sneaky Killer

CO in tactical vehicles

- Because of the extreme cold, guards were allowed to run the heater in the truck-mounted shelter for 10 minutes each hour. They were instructed to open vents and have adequate ventilation. The soldier was discovered inside a sleeping bag in the shelter with the vents closed and the heater running. He died of carbon monoxide poisoning.

- To keep warm, the sergeant slept on the deck of the M730 Chaparral carrier with the main power unit running. Shortly after being awakened, he collapsed. He was taken to the hospital where he was treated for carbon monoxide poisoning. Luckily, he survived.

Carbon monoxide (CO) is a gas you cannot see, taste, or smell. It won't tickle your throat or make your eyes smart, or in any other way make its presence known. Carbon monoxide is dangerous because it sickens and kills by cutting off the oxygen supply from the body's tissues.

The oxygen one breathes combines with red blood cells and circulates through the body. Just breathing oxygen isn't enough. It must combine with the red blood cells to maintain life. CO combines with red blood cells 200 times more easily than oxygen. When oxygen and sizable amounts of CO are breathed together, CO displaces oxygen. Air containing one percent carbon monoxide can kill a person within 5 minutes. And it all happens without a sound.

Symptoms

The symptoms of carbon monoxide poisoning are tightness across the forehead followed or accompanied by throbbing in the



temples, headache, weariness, weakness, dizziness, nausea, loss of muscular control, and increased pulse or respiration.

Precautions

Soldiers often seek warmth without considering the danger. The following precautions will help ensure safety:

- Do not operate vehicle heater or engine in an enclosed area unless it is adequately ventilated.
- Do not idle engine for long periods without maintaining adequate ventilation in personnel compartments.
- Do not drive any vehicle with inspection plates, cover plates, or engine compartment door removed unless necessary for maintenance purposes.
- Be alert at all times during vehicle operation for exhaust odors and exposure symptoms.
- Do not sleep in tightly enclosed areas, near vehicle exhaust, in vehicle cabs, or in generator trucks.

The best defense against carbon monoxide poisoning is adequate ventilation, whether it is in the home, a vehicle, or workplace. Remember, carbon monoxide gives no warning of its presence. It sneaks in.

Batteries Need Careful Handling

- Sergeant was jump-starting a D-8 dozer. When he connected the last jumper cable, the battery exploded in his face.
- Employee was carrying a filled battery when the handle broke. When the battery fell, acid splashed into his eyes.
- Supply clerk was lifting a battery to place it on a pallet when the carrying handle broke. The battery landed on his right foot.
- Mechanic was on top of an M60 handling batteries to his coworker inside. His back made a sudden snapping noise, and he couldn't straighten up.

These are samples of the injuries batteries cause Army personnel. Harmless-looking as they are, batteries should always be handled as if they were potentially dangerous, because they are.

Batteries do splash acid on people, and they do explode. They are also heavy and awkward to handle. In fact, the leading type of battery-related injury involves sprains and strains.

Lifting batteries

There is no quick and easy way to hand batteries down into a tank. It must be done deliberately and cautiously, with alertness, to avoid twisting and overexertion. Mechanical means should be used to move batteries whenever practical. In other situations, two people may do the lifting. The rule to follow is: When in doubt, get help.

Protective equipment

The electrolyte in batteries is corrosive and may splash or drip out. Sealed goggles and rubber or acid-resistant gloves must always be worn when handling them. When performing battery maintenance, people should wear face shields and acid-resistant aprons in addition to the gloves.

The handles of some batteries can become saturated with electrolyte and can become corroded and break. It's safer to use a battery carrying clamp or handle. If the built-in handles are used, the battery should be held away from the body when carried—just in case—and, of course, steel-toed shoes should always be worn.

Battery types

Different types of batteries present different hazards in varying degrees. But all batteries require great care in handling and respect for their injury-causing potential.

Primary cell batteries—nonrechargeable, disposable types such as zinc-air, mercury, carbon-zinc, and alkaline—are in common use. They should be turned in for disposal when they show signs of leaking electrolyte, corrosion, or unusual temperature increase. One type, lithium, is increasing in use in equipment such as night vision devices. The lithium battery is a high energy density power source with highly reactive components. These batteries may emit corrosive and highly toxic chemicals if not handled with care. As is the case with other primary batteries, any attempt to recharge them could set off a violent chemical reaction.

A battery that has a charge-discharge cycle is known as a secondary battery. The most commonly used types are alkaline, with potassium hydroxide solution as the electrolyte, and lead-acid batteries in which sulfuric acid solution is the electrolyte.

The lead-acid storage battery stores power for the electrical system in most vehicles. Proper care of this battery is most important. Excessive charging or discharging shortens the life of the battery and the electrical accessories. Distilled water should be added as needed to keep the liquid (electrolyte) level above the battery plates.

In both alkaline and lead-acid batteries, chemical changes take place during the charge and discharge functions. These changes produce hydrogen gas. This gas, contained in the bubbles you see through the vent hole, can explode if ignited. Ignition sources include the obvious—matches and lighters. Then there are the less obvious sources. Tools falling on batteries and causing a spark have produced many explosions.

Caution your people always to take two precautions to protect themselves from battery explosions:

1. Keep all possible ignition sources away from batteries.
2. Keep face away from battery as much as possible and use eye protection.

Jump-starting

Batteries are prone to explode during jump-starting. This is especially so if the jump-starting is done incorrectly. Therefore, always have your people wear eye protection, keep their faces well back, and follow proper procedures to the letter:

- Connect only batteries of the same voltage.
- Check dead battery for damage and electrolyte level. Add distilled water if necessary. If battery is damaged or electrolyte is frozen, **do not** jump-start. There might be gas pockets in the ice.
- Get the good battery and the dead battery as close together as possible, but don't allow the vehicles to touch.
- Place vehicles in "park" or "neutral" with emergency brakes ON and ignitions, master switches, and all electrical and electronic switches OFF.
- Cover vent openings of both batteries with rags to prevent possible battery-acid splatter.
- Connect one red-end clamp to the positive (+) battery post of the **dead** battery. If you can't see the positive (pos, P, or +) or negative (neg, N, or -) markings on the post, don't guess! Forget it until you can absolutely identify which is which.
- Connect the other red-end clamp to the positive (+) post of the **good** battery.
- Connect one black-end clamp to the negative (-) post of the **good** battery.
- Carefully connect the other black-end clamp to some large metallic part of the dead vehicle's engine block. If the battery is not in the engine compartment, connect to the frame or some unpainted part of the body. This final connection is the one that sparks, so keep it as far from the battery as possible. **Never** connect the cables to the dead battery's negative (-) post. Take special care to keep the jumper cables away from the fan belt or other moving parts.

Start the working vehicle, and run it at idle. Then start the other vehicle.

- Once the other vehicle is running, immediately disconnect the jumper cables in the exact opposite order from that in which they were connected. The first cable you disconnect will cause a spark, so remove the one farthest from the battery first. This time it's (1) black-end clamp from engine or frame; (2) black-end clamp from good battery; (3) red-end clamp from good battery; (4) red-end clamp from formerly dead battery.

To jump-start or slave-start wheeled or tracked vehicles, place vehicles side-by-side if possible; otherwise, park them at right angles (with main guns traversed to the rear). Do not allow anyone to be between the vehicles, and clear the front. Vehicles being jump-started have been known to jump forward.

For additional jump- and slave-starting guidelines, consult the applicable vehicle manual.

Precautions

Battery charging areas should be well-ventilated and equipped with eye-wash and shower facilities. If electrolyte gets in the eyes, they should be flushed for at least 15 minutes in running water with the eyelids held open. Complete drenching is called for in cases where electrolyte contacts the body. Follow-up treatment in a medical facility is mandatory.

Incineration of batteries is hazardous and is not an acceptable method of disposal. All unusable batteries should be turned in for disposal in accordance with the appropriate parts manual.

Tires Are Major Safety Device

The second most important safety device on a wheeled vehicle (after the brake system) is its tires.

Correct air pressure is the basis for reliable tire performance. Tires are designed to operate at specified air pressures, which are normally different for light and heavy loads and for different operating conditions. It is important that the pressure be checked at least weekly using an accurate gauge and inflation adjusted as indicated. A tire that appears low during the daily preventive maintenance checks and services (PMCS) should be checked with a gauge, too.

Why all the bother? To help preserve the tires and also the vehicle, driver, and passengers.

- Underinflated tires will give the vehicle a sluggish, squashy feel, and can make the vehicle hard to control in a crisis.

- A tire that's only 25-percent low—hardly enough to see—can lose one-fifth of its useful life.

- Underinflated tires waste fuel.

- Underinflated inner duals can cause costly and dangerous fires.

- A tire that is operated while underinflated will show greater wear on the outside edges of the tread than in the center.

- Overinflation also causes tire failure. Excessive pressure prevents the tire from flexing enough, so that it is repeatedly subjected to hard jolts. The cords may snap, causing a break in the cord body.

- A tire that is overinflated will show greater wear on the center of the tread than on the outside edges.

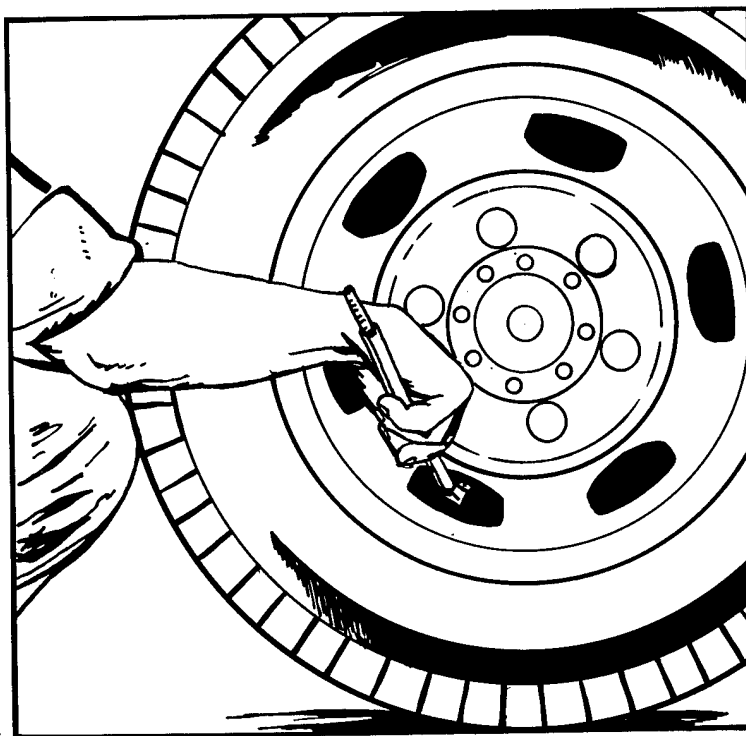
All inflation pressures are cold inflation pressures. This is the pressure after the tire has been standing for at least 3 hours or driven less than 1 mile after standing for 3 hours. The inflation pressure will increase as the tires warm up. Air should never be bled from hot tires to reduce the pressure to the cold inflation recommendation.

Normally the tire pressure check will be performed in conjunction with the other weekly PMCS. When your unit goes to the field, be sure a tire pressure gauge is included with those minimum-essential tools that go along. A vehicle with its own air supply (2 1/2-ton and larger) also has its own gauge, but be sure there's one available for the smaller vehicles. If a tire is found to need air, you can get it from a wrecker or other air-supplied vehicle.

A daily check of the outside of the tire is essential, too. If it has any gouges or cracks that could cause fire failure, any sidewall or tread bulges that indicate ply separation, tread depth less than 1/8-inch, or exposed cords, replace it before driving the vehicle.

Tires are constantly subjected to cuts by sharp objects and bruises from rough driving surfaces, stones, and shocks in general. It would seem to be plain common sense not to trust your life to a tire that looks like it's just waiting for the right minute to blow out, but a recent fatal Army motor vehicle accident began with the blowout of just such a tire.

The daily visual inspection and weekly tire pressure check take only a few minutes, and they are minutes well spent for safety, riding comfort, and protection of equipment.



Poor Maintenance Proves Costly

The private operating the roadgrader had worked on the land-clearing project all day. Work to clear 120 acres of land and build two access roads had begun a few months earlier. The heavy equipment had been used 7 days a week and, for the last few weeks, from morning well into darkness.

The project was finished at 1600, and the vehicles were taken to the washrack to be cleaned before sending them back to the installation. After the roadgrader was cleaned, the driver was told to drive it to the motor pool. About a half-mile from the washrack, while going up an 8-degree slope, the roadgrader came to a stop near the crest of the hill and began to roll backwards. While trying to pass the grader, the driver of a pickup truck was run off the left side of the road by the grader.

The private then steered the grader to the right side of the road and into a ditch. The grader climbed a 6-foot bank and stopped. It started teetering, and the private jumped from the left side onto the pavement and fell. The grader turned over and pinned the private underneath, killing him.

Accident facts

- Inspection showed the roadgrader was in a nonoperable/deadlined status before the day of the accident. The handbrake system was disconnected; the transmission brake line was bent; the clutch brake lever was not connected; seatbelts were not installed; and the front wheel tilt bar was broken. The steering arm lock nut was loose. It came off completely when the grader was moved forward about 10 feet, rendering the steering system inoperable.

- Unit command emphasis on equipment maintenance was inadequate. Most of the deficiencies had probably existed for a long time, but the grader was allowed to operate despite them.

- The private drove the roadgrader knowing it had bad brakes.

- The driver was undergoing on-the-job training. He was not licensed to operate this vehicle but was considered a competent operator. He was used to driving a newer roadgrader with an automatic transmission and hydraulic controls.

- Personnel conducting the on-the-job training were not following procedures to document the training. The unit could not produce records of training the private and eight other personnel had received.

Actions taken

- All assigned personnel were told the facts and circumstances of this accident.

- A command letter stressing the importance of proper maintenance was distributed to the lowest level of the brigade.

- Brigade command inspections of company-size units were started. These inspections evaluate company maintenance and require immediate corrective action on inspection findings.

- During brigade command inspections, records are inspected to ensure on-the-job training is being conducted and documented according to published procedures.

- Active chain-of-command involvement in maintenance and maintenance training has been directed.

Lifting Devices Cause Injuries in Maintenance Facilities

Safety goals set by the President, Secretary of Defense, and Secretary of the Army required a 3-percent reduction in civilian and military injuries each year for the 5-year period FY 84 through FY 88. The Army failed to meet this goal in both FY 84 and FY 85.

A primary reason the Army is not meeting its safety goals is a steady rise in personnel injury accidents. These accidents accounted for almost half of all Army ground accidents during a recent 5-year period. Maintenance, repair, and servicing activities are the main problem area. These activities are responsible for 25 percent of all military and civilian on-duty personnel injuries. They account for more than 2,500 injuries, 27,500 lost workdays, and a cost of \$8.6 million annually.

Lifting-device-related accidents

A look at maintenance, repair, and servicing accidents revealed that accidents most often occurred in wheeled and tracked vehicle facilities. One specific problem area found involved lifting devices. Three major task errors associated with lifting devices were:

- Personnel did not use the correct jack, lift, or hoist as specified in the appropriate vehicle technical manual for the maintenance task performed.

- The lifting device had not been load-tested before use in accordance with TB 43-0142.

- The operator did not properly inspect load security before and/or during the operation.

These task errors led to loads unexpectedly shifting or falling and resulted in injuries, primarily to the operators involved. Nineteen accidents that were analyzed in depth resulted in 19 injuries, 224 lost workdays, and \$111,840 in total accident costs. These figures, however, represent only a small portion of all maintenance activities. Following is a conservative estimate of annual lifting-device-related accidents in all maintenance activities: Accidents—276; injuries—278; lost workdays—3,579; total costs—\$3,376,109.

These examples of lifting-device-related accidents exemplify the three major task errors.

- Although he was going by the book, the soldier used improper procedures to remove the transmission from an M35A2 2 1/2-ton cargo truck. The hoist he was using was inadequate for the load and it failed. The transmission fell and crushed the soldier's right forearm. The TM 9-2320-209-34-2-1 he was using had been superseded a year earlier. His supervisor did not ensure a current manual containing proper procedures was available.

- Because a hydraulic jack was not available, the soldier tried to remove the transmission from an M35A2 2 1/2-ton cargo truck with a chain attachment, contrary to TM 9-2320-209-34-2-1. The transmission came loose and dropped to the floor. As it fell, it hit the soldier's arm, resulting in a compound fracture.

- While installing the firing pin in a 105mm gun breech block, the soldier did not secure the breech block with a chain hoist, contrary to TM 9-2350-215-10-3. The breech block fell, and the soldier's finger, which was caught in the firing pin well, was partially severed. He had not been adequately trained to perform the task.

- An unserviceable hydraulic gear raiser failed during removal of a transfer case on an M816 5-ton truck because the device had not been tested and tagged inoperable, contrary to TB 43-0142. The transfer case fell on the soldier's foot, breaking several bones.

- While attaching a lifting chain to the hoist block, the soldier focused his attention on the sling assembly and load he was repositioning. Because of this, he failed to inspect the top ring of the lifting chain which was not firmly secured. The connecting ring to the pulley broke and the load fell. It landed on and broke the soldier's foot.

Actions to be taken

The majority of these injuries were caused by unsafe acts on the part of the individual involved—primarily failure to follow correct procedures. Maintenance commanders can reduce lifting-device-related accidents by:

- Ensuring all authorized jacks, hoists, lifts, and the appropriate manuals and operating instructions are on hand and properly used.

- Conducting unscheduled spot inspections to ensure compliance with safe operating techniques and procedures.

- Complying with TB 43-0142 and TM 38-70 to test and mark all lifting devices, to ensure equipment serviceability, and to conduct daily inspections.

- Holding personnel accountable for safe conduct on the job.

- Rewarding safe performance and compliance with procedures.

- Increasing command emphasis on training, performance follow-up, and safety.

Inspection and Testing of Lifting Devices

Inspection and testing of lifting devices (excluding jack stands and on-vehicle equipment) is governed by TB 43-0142: Safety Inspection and Testing of Lifting Devices. The major portion of this bulletin establishes inspection and testing procedures for implementation at installation level.

Inspecting, testing, and maintaining lifting devices are the installation commander's responsibility. However, it is the operator of such devices who ends up injured or held accountable for damage to equipment when a lifting device fails or malfunctions. To prevent injuries and equipment damage, testing and inspection procedures for lifting devices are outlined in the bulletin and are summarized as follows:

- **Load testing.** Accomplished before initial use of all new, extensively repaired, or altered lifting devices.
- **Daily inspection.** Performed by the operator before use.
- **Periodic inspection.** Conducted at least every 12 months by organizational maintenance personnel (may or may not include function test).
- **6-month inspection.** Completed before use of a lifting device that has been idle for 6 months or more.

Inspection criteria are outlined in TB 43-0142 for daily, periodic, and 6-month inspections.

It is also important to record these tests and inspections. Accordingly, the bulletin specifies documentation procedures that will be established for each lifting device. It also establishes a marking system for each device to indicate load capacity rating, date of next periodic inspection, and item identification number, if applicable.

Following are recommendations to assist users in establishing a program to ensure all lifting devices are operated and maintained in a safe manner.

- Appoint an individual who is knowledgeable in lifting-device operations as overall point of contact (POC) for testing and inspecting lifting devices.
- Have the POC coordinate with the equipment manager to ensure timely inspection and testing of lifting devices.
- Establish a training and qualification program for all operators.
- Maintain permanent records of inspections and load tests.
- Have all lifting devices marked, labeled, and tagged in accordance with TB 43-0142.
- Attach copies of daily inspection instructions on or near all lifting devices.
- For more complicated devices such as cranes and hoists, attach a copy of operating instructions in the vicinity of the operator control area.
- Address lifting-device safety at unit safety meetings on a recurring basis.
- Ensure that all authorized lifting devices and those required by vehicle maintenance manuals are available, serviceable, and used.

Dangerous Handtools

The most common and simplest of handtools--hammers, pliers, and screwdrivers—are also a common cause of maintenance-related accidents. The following accident data for a recent 12-month period illustrates how costly these accidents can be:

Days lost—1,035
Days hospitalized—93
Days restricted duty—562
Injury cost—\$164,470

These accidents occurred to on-duty military and civilian personnel performing general maintenance and repair work and to military personnel in the tactical environment. Most of the accidents occurred during tactical vehicle maintenance and service.

Not taking the time to do the job right was the most frequent cause of these accidents. Personnel failed to concentrate on the task at hand or tried to hurry the job.

In other cases, inadequate supervision allowed incorrect procedures and incorrect tools to be used. A lack of supervision allowed shortcuts to be taken, and these shortcuts led to both poor job quality and personnel injuries.

Inadequate unit training was also a factor in some of these accidents. Personnel often lacked knowledge of proper tools and procedures and the skill to perform assigned tasks.

Inadequate written procedures resulted in maintenance personnel not knowing what to do when the required tool was not available. Unit SOPs and training must address the proper use of tools and what alternatives exist if required tools are not available.

Unit Maintenance Safety Program

"To accomplish our missions, the nation entrusts to our care its youth and its resources. There can be no greater responsibility. As stewards of the Army's assets, we must be alert for ways to improve the efficiency, effectiveness, and safety of all our operations. The very serious responsibility for maintaining what we are given is based on the hard reality that we will never have all the equipment, supplies, facilities, and funds we require. Thus, a well-trained soldier must be taught to maintain and conserve what he has—in peace and in war."

The words of General John A. Wickham, Jr., Chief of Staff, Army, stress the importance of good maintenance programs to the Army. And a good maintenance safety program is the key to a good maintenance program.

It all begins at unit level. Integrating safety into a maintenance program consists of a few relatively easy tasks.

- **Develop a maintenance SOP.** This document sets forth required safety procedures for the maintenance operation. It must include guidelines for performing tasks safely, the proper use of handtools and personal protective equipment, and proper lifting procedures. The maintenance SOP must be reviewed at least annually and revised as appropriate.

- **Ensure personnel are trained and qualified.** Before supervisors assign any maintenance task, they should make sure the person they assign is trained and qualified to perform it. They should review the task to determine the number of personnel needed and whether any other resources such as special tools or personal protective equipment are required. The maintenance manual will usually provide this information, but not always. If, when reviewing a task in the manual, it becomes apparent that needed information is not available or is unclear, the supervisor should submit a DA Form 2028 to clarify the task.

- **Conduct periodic refresher classes.** These classes serve to update and strengthen training on maintenance tasks. This type of training will identify weaknesses and bad habits that can then be corrected immediately. Good habits that must be stressed include proper use of tools and equipment; proper lifting techniques, proper body positions for tasks; use of personal protective equipment; security of components and equipment during the task; adequate inspection of parts, tools, equipment, and work areas; communication between coworkers; following procedures; and depressurizing or disconnecting components or equipment before maintenance begins.

- **Emphasize the importance of safety.** Weekly tailgate sessions in which personnel discuss common safety problems will emphasize the importance safety plays in maintenance activities. They will also serve as reinforcement for good safety habits. Discussions of upcoming maintenance activities with emphasis on proper procedures, required personal protective equipment, and avoidance of potential hazards will set the tone for a safe maintenance work week. Information for these sessions can be found in maintenance manuals, at the local safety office, and in this publication.

Maintenance activity accidents account for almost one out of every five on-duty personnel injury accidents. These accidents usually get little attention and often little in the way of prevention because, looked at individually, they often seem to be only isolated "bad luck" events. But looked at collectively, they represent a serious loss of the Army resources General Wickham spoke of.

Now is the time to improve your unit maintenance safety program to prevent these losses.

Tire Servicing the Safe Way

Soldiering can be hazardous duty even in peacetime—especially if you're around weapons, ammunition, explosives, or . . . tires!

Mechanics—and drivers too—are handling what amounts to a loaded, cocked gun when they service a tire on a multi-piece rim. This "gun" has a hair trigger. Missing any tiny detail during deflation, disassembly, assembly, or inflation can set it off.

A fully inflated truck or bus tire rams tons of pressure against the rim lock ring. If the lock

ring blows off, it travels with tremendous force, sometimes over a surprising distance. Even if it misses the mechanic, it can take out a bystander in the area of trajectory.

That's why one of the first rules in your training is, "always inflate the tire in a safety cage."

Warning

Never—but NEVER—go by this instruction found in some TMs: "... if safety cage is not available ... lay the tire flat, with ring down, and reach through wheel to apply air chuck."

True, if the lock ring blows off, it will go down—but the tire and rim will go up like they were shot out of a cannon. There's even danger in tires on single piece rims. A tire explosion can blast with the force of a bomb!

OSHA standard applies

Servicing tires—especially those on multi-piece rims—is no job for the untrained ... or for the foolhardy. A person's first mistake can be his last!

People who service certain types of tires and rims must be trained under OSHA Standard 1910.177. It covers servicing multi-piece and single-piece rim wheels used on large vehicles such as trucks, tractors, trailers, buses, and off-road machines. The standard applies to many vehicle drivers and other equipment operators as well as to mechanics who disassemble and assemble tires and rims. Simply "airing up" a soft tire can be dangerous. A tire that's been rolling on only 80 percent of its specified pressure can be a fuzed bomb. The lock ring may have shifted and can blow off when air is added to the tire.

Tire training for mechanics includes use of two charts:

- Safety Precautions for Mounting and Demounting Tube-Type Truck/Bus Tires.
- Multi-Piece Rim Wheel Matching Chart.

The OSHA standard tells how to get these charts.

—adapted from PS magazine

Repeat of Tire Inflation Procedures

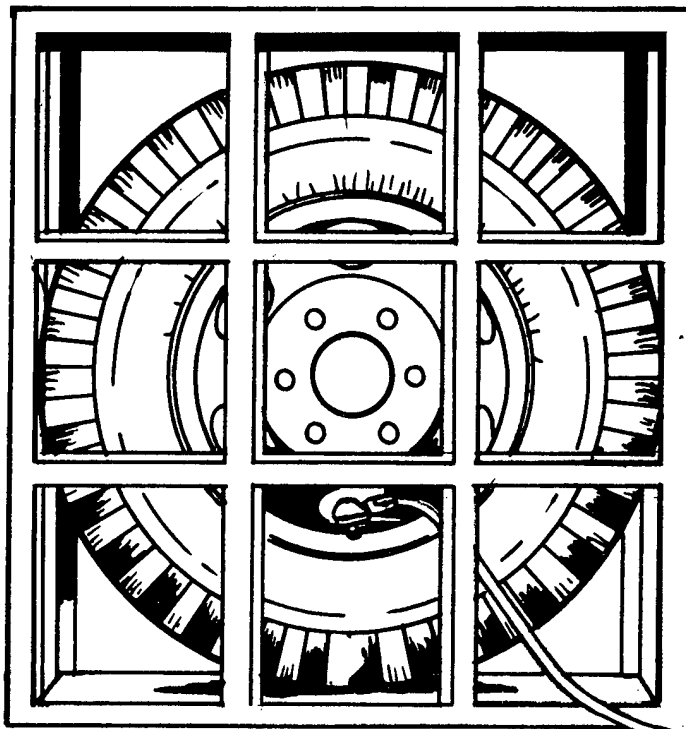
In January 1986, TACOM sent safety-of-use message 86-2 on maintenance procedures for all pneumatic tire and rim assemblies. In March, they retransmitted the message (211400Z Mar 86) because soldiers are still getting hurt. Following is the text of the message:

Overinflation has caused five tires to explode while soldiers were trying to seat the tire beads. Four soldiers were hurt in these explosions.

Current mounting procedures outlined in TM 9-2610-200-24: Care, Maintenance, and Repair of Pneumatic Tires and Inner Tubes, 1 February 1985, are misleading. The procedures will be changed to provide the following safety precautions:

- Use an inflation cage to inflate any tire not mounted on a tire-changing machine that has a positive lock-down device to hold the tire and rim assembly. Always follow approved mounting and safety instructions when using a tire-changing machine.

- During inflation, if both beads do not properly seat when tire pressure reaches 40 pounds per square inch (psi), completely deflate the assembly, reposition the tire and/or tube on the rim, relubricate, and reinflate. Never inflate beyond 40 psi to seat beads. After the beads



are fully seated, pressure may be increased as stated in the vehicle technical manual. Never exceed maximum inflation pressure shown on the tire sidewall.

- Never try to mount a tire on a rim that is not the same diameter as the tire. For example, never mount a 16-inch commercial utility cargo vehicle (CUCV) tire on a 16.5-inch M880 rim. It is easy to mistake these two rims for each other, as appearance and lug hole patterns are similar. Correct rim size is stamped on the **outside** of the CUCV rim (16x6) and on the **inside** of the M880 rim (16.5x6.75).

It is possible to pass a 16-inch tire over the lip or flange of a 16.5-inch rim, but the tire bead will not seat against the rim flange. Trying to seat the bead by increasing pressure may cause the bead to break with explosive force and seriously injure or kill someone.

The above changes will be in Technical Bulletin 43-0001-39-2: Equipment Improvement Report and Maintenance Digest, second quarter FY 86.

Rings and Things

Rings and things are great—some places. AR 670-1 authorizes the wearing of a wrist watch, an ID bracelet, and two rings with Army uniforms unless prohibited for **safety or health reasons**. But some soldiers wear them at the wrong time and place.

- The soldier lost his balance as he dismounted the 5-ton truck on which he was performing maintenance. He grabbed for the rearview mirror, and his ring caught on the mirror support bracket. As he fell to the ground, the ring ripped off his left ring finger at the first joint.

- The soldier was working on the 5-ton wrecker in the motor pool. As he climbed down from the wrecker, his ring caught on a metal pin on the boom. He reached up to free the ring and lost his balance. His ring remained snagged on the boom, and the weight of his falling body severed his finger at the middle knuckle.

- After taking the tarp off his load, the soldier jumped off the trailer. His class ring caught on the sideboard and severed his right ring finger just below the middle knuckle.

- While unloading equipment, the sergeant jumped off the trailer. A ring on his little finger caught on a hook that houses the canvas, and his finger was cut off.

Sound a bit repetitious? It is. And these losses were so unnecessary.

The SOP in DA Pam 750-35, which must be established in each motor pool throughout the Army, contains a safety annex that states: "Remove all jewelry (i.e., rings, chains, watches) when working on equipment."

One safety item listed in DOD 4145.19-R-1, the regulation on handling material, states: "Finger rings will not be worn."

Regulatory guidance clearly says rings will not be worn in motor pools, maintenance shops, when working on equipment, or when handling material. In addition, commanders have authority to require soldiers to remove rings in other places and at other times for "safety or health reasons."

So why are soldiers still wearing rings and losing their fingers? Don't they know they shouldn't wear the rings? Doesn't anyone ever check? Aren't the regulations enforced?

References

- AR 670-1: Wear and Appearance of Army Uniforms and Insignia.
- DOD 4145.19-R-1: Storage and Materials Handling.
- DA Pam 750-35: Functional Users Guide for Motor Pool Operations.

Shop Safety

Safe shop operations contribute to an effective maintenance program. Safety becomes second nature when supervisors, leaders, and commanders enforce commonsense safety rules. These rules include the following:

- No smoking in shop areas.
- Proper storage of flammables.
- Clean, well lit, and ventilated work areas.
- Use of ground guides.
- Low speed limits.

- Proper grounding of electrical equipment.
- Training in use of fire extinguishers.
- Use of protective clothing and equipment.
- Parts, tools, and loads secured before vehicle movement.
- Tools and equipment inspected before use.
- Use of only approved cleaning solvents, never gasoline.
- Use of chock blocks and jack stands.
- Proper use of tools.
- Proper recovery and storage of used POL.
- POL spill control.
- No horseplay.
- Proper use of compressed air and hydraulic equipment.
- Use of safety cages when inflating tires.

—from DA Pam 750-35: Functional Users Guide for Motor Pool Operations

Quiet Danger: Carbon Monoxide

• It was cold. The onboard generator was running, so the two soldiers sat under the cargo cover on the deck of the M48A1 trying to keep warm. Carbon monoxide from the generator collected under the cargo cover. The soldiers became ill from inhaling the gas.

• The employee was using a forklift in a closed warehouse. He was overcome by carbon monoxide.

• The truck driver began feeling dizzy and sick to his stomach. By the time he got back to his duty station, he was constantly vomiting and was taken to the hospital. A hole in the exhaust pipe of the truck had let carbon monoxide enter the cab.

• The soldier, his wife, and their infant son died in their home of carbon monoxide asphyxiation. The gas could not escape up a blocked chimney.

Carbon monoxide can't be seen, tasted, or smelled. It won't tickle your throat or make your eyes smart. It sickens and kills without a sound.

The earliest symptom of carbon monoxide asphyxiation is usually a headache accompanied by dizziness, blurred vision, and sleepiness. With continued exposure comes shortness of breath, nausea, vomiting, fluttering and throbbing of the heart, and finally unconsciousness. Not all the symptoms occur in every case. Symptoms may show up so gradually that victims may not be aware of the danger. They become drowsy and fall asleep—permanently. The length of exposure and concentration of carbon monoxide are important. Air containing only 1 percent of carbon monoxide can kill a person within 5 minutes.

Precautions

• Ensure there is adequate ventilation, whether at home, in a vehicle, or in the workplace. Adequate ventilation is the best defense against carbon monoxide asphyxiation.

• Check vehicle exhaust systems, especially for blown gaskets, leaking pipe connections, and holes in mufflers and tailpipes.

• Do not sleep in tightly enclosed areas, near vehicle exhausts, in vehicle cabs, or in generator trucks.

• Be alert to the dangers of makeshift heaters—charcoal grill, gas lantern, hibachi. Such heaters require a great deal of ventilation to operate safely.

• Have home heating equipment checked periodically.

Remember, carbon monoxide gives no warning of its presence. It comes quietly and does its damage without a sound.

Brake Failures Increase

A review of FY 84 through FY 86 accident data indicates that brake-related accidents are still on the increase. There were 148 in FY 84 and 156 in FY 85. They again increased in FY 86 to 162. This continuing increase points up the need for more stringent unit-level command emphasis.

There are basically three causes of accidents involving brake system failures: improper repair

or maintenance, lack of individual responsibility, and materiel defects. Command emphasis is the only tool that will correct these faults and assure a good preventive maintenance safety program.

Repair and maintenance

Only new parts should be used to replace brake system components. While Cam-Point parts that have been cleaned might appear to be serviceable, they may, in fact, be mechanically unsound. The quick fix or field expedient repair can be deadly when dealing with brake systems. These methods of repair have no place in peacetime operations.

Brake line fittings should be properly connected to prevent cross threading. Cross threading of fittings could cause leaks in the air and fluid systems. Lines that have bends near fittings could develop pressure leaks due to vibrations during operation.

All brake lines must be constructed with the correct diameter and gage steel tubing. Some tubing that appears to be steel may have only a light exterior coating. Checking for worn mounting bolts, pins, springs, and lines must be part of every operator's and mechanic's inspection. The rule should be that if it looks worn or cracked, replace it.

Fluids added to the system should be the correct type and free of contaminants. The fluid levels should be maintained at proper levels. All brake fluids should be stored in closed containers and at specified temperatures. This prevents contamination from moisture and dust.

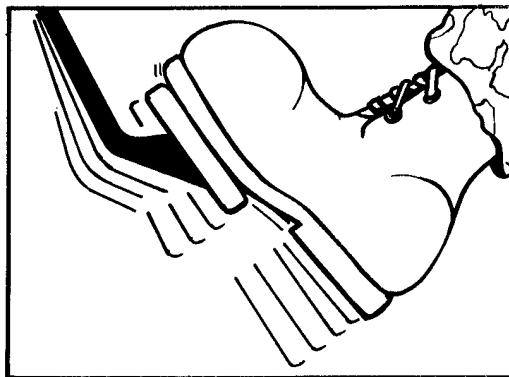
Mechanics at all levels should make a complete inspection and subsequent operational test of the brake system after any repairs. The shop supervisor or motor sergeant should verify proper completion of any brake work done before the vehicle is returned to the using unit or operational ready line. Vehicles not in operational condition due to brake system problems should be red-tagged at the steering wheel until repaired.

Individual responsibility

• **Leaders.** While costing nothing but time, proper command emphasis can save lives, equipment, and money. It can be the most cost-effective countermeasure a leader has. Commanders and leaders at all levels need to display a concern for safe vehicle operations to their maintenance personnel and operators alike. Leaders should ensure that all motor pool and support maintenance personnel are properly trained on the systems they are charged with maintaining and that all operators are properly trained, licensed, and familiar with the equipment they are to operate. Leaders' responsibility doesn't end by telling subordinates to accomplish this or that mission. They must check periodically to ensure missions are completed properly.

• **Maintenance personnel.** Motor sergeants, mechanics, and dispatchers must ensure that operators are properly performing their PMCS. They should also have operators assist in scheduled maintenance services. This will allow operators to become familiar with systems and parts of their equipment that might otherwise be overlooked. Motor pool mechanics should check the operators' maintenance. The dispatcher should check the operator's SF 46 and DA Form 348 and ensure that a proper dispatch is completed. The motor sergeant should spot check personnel to ensure they are performing their duties as required. The motor sergeant is also responsible for vehicle control and security. Motor sergeants should check the DA Form 348 and SF 46 of each individual when first assigned to the unit and, if any doubt of validity arises, have the individual relicensed.

• **Operators.** PMCS is just the starting point of drivers' responsibilities for their equipment and the successful completion of their mission. Operators must always be on the lookout for safety as well as mechanical problems with their equipment. Army motor vehicles that will not stop properly are vehicles that should not be operated. Operators must be aware that, as they are selected to operate a new type of equipment or one they have not operated recently, they must become fully familiarized with the equipment before operating it. Every vehicle braking system has its own unique characteristics, such as stopping distance and response time. Such things as weather, terrain, and road conditions also affect response to the application of the brake system. Any doubt about the serviceability of a brake system should be checked out with unit



maintenance personnel for clarification. Doubt can be a killer and a mission stopper.

Materiel defects

Sometimes defects occur during manufacturing of individual parts or assembly of parts into components, subassemblies, or major assemblies. When such defects are found, it becomes the responsibility of the entire chain of command to ensure that the problem is reported through the proper channels (using EIR, QDR, etc.) so it can be corrected.

Know Asbestos Dangers

Actions are under way throughout the automotive industry to replace asbestos as a brake shoes and clutch disk material. At present, however, most brake friction materials do contain asbestos, which happens to be one of the most potent cancer-causing substances known.

The whole U.S. population is exposed to asbestos to some degree, much of it becoming part of the air they breathe as it's worn off the linings of vehicle brake shoes and clutch disks. One study found asbestos fibers in the lungs of 96 percent of urban residents who were tested. Except when highly concentrated, the particles can't be seen, felt, or smelled, but they are easily inhaled. Every particle that enters the lungs stays there—it never dissolves or decays. Over a period of years, the accumulation of fibers can produce asbestosis, a debilitating lung disease, or cancer. It doesn't take much exposure—a teaspoonful can kill a person.

Army personnel most at risk are vehicle mechanics. The average vehicle goes through about four sets of brake shoes and a couple of clutch disks in its lifetime, and airborne asbestos can be produced when linings are ground or brake assemblies cleaned. It is essential that mechanics follow asbestos control procedures during brake servicing. In addition, entrances to areas where brake work is done should be posted with an asbestos exposure sign containing the following information:

Asbestos Dust Hazard
Avoid Breathing Dust
Wear Assigned Protective Equipment
Do Not Remain in Area Unless Work Requires It
Breathing Asbestos Dust May Be Hazardous to Your Health

Besides brake shoes and clutch disks, major uses of asbestos are in cement products, floor tiles, fireproofing, high-temperature insulation, asbestos cloth, and various gasket materials. Typical work tasks involving asbestos include:

- Fabrication, installation, repair, or removal of asbestos insulation such as pipe coverings and sprayed-on materials.
- Power sawing or sanding of fire retardant building materials.
- Demolition or renovation of buildings.

In these activities, as in replacement or removal of brake drums or pads and clutch linings, dust containing asbestos fibers is released. Personnel who perform such tasks must comply with the requirements of 29 Code of Federal Regulations (CFR) 1910 (OSHA Safety and Health Standards), section 1910.1001, Asbestos.

Asbestos in woven fiber form must also be used with caution. It occurs in—

- Hot mitts and gloves.
- Fire blankets.
- Firefighters' thermal protective coats.
- Lab hot plates.
- Asbestos wire gauze.
- Electrical heating materials.
- Welding screens.

These items should be inspected periodically to ensure the woven material is intact. If the material becomes frayed, worn, or water damaged, or if protective linings and coatings are damaged or missing, the item should be disposed of and replaced with an asbestos substitute

material if available.

Danger of inhaling asbestos particles occurs wherever the material containing asbestos is **friable**. That means it can be crumbled, pulverized, or reduced to powder in the hand, or that it readily releases fibers with only slight disturbance. When you are uncertain as to whether a piece of equipment presents an asbestos hazard, consult your Preventive Medicine Activity.

WARNING! AMV Brake and Clutch Maintenance Can Be Health Hazard

This article first appeared in the April 1985 Countermeasure. It has been updated by Mr. J. Earl Swindell, Preventive Medicine Service, Fort Stewart, GA, to reflect current asbestos control procedures. Mr. Swindell has also supplied detailed procedures for asbestos control during brake and clutch repair that can be included in your SOP or LOI. If you would like a copy, write U.S. Army Safety Center, ATTN: CSSC-M, Fort Rucker, AL 36362-5363, or call AUTOVON 558-2062/4806.

The last time one of your AMV mechanics used an air hose to blow out a brake drum, he sent a cloud of asbestos fibers freewheeling through the air and probably right into someone's lungs.

Remember that gray-black powder that fell on the floor when he pulled the brake down? That contained asbestos fibers which are dangerous when inhaled into the lungs.

Some of our vehicle maintenance manuals have no danger or warning about these asbestos hazards, but they should—and will as soon as the changes are published.

Asbestos has been found to produce severe lung damage in the form of disabling or fatal fibrosis of the lung, termed asbestosis. It has also been found to be a factor in the development of lung cancer and is suspected of contributing to cancer of the gastrointestinal tract. The effects of asbestos exposure are not immediate, but can show up 20 to 30 years after the first exposure. It has been found that smokers who work with asbestos have a much higher potential of developing lung cancer than do nonsmokers. Those who stop smoking will gradually reduce this risk to a level no greater than that of nonsmoking asbestos workers.

When a mechanic is servicing or replacing components containing asbestos, the "solvent method" or "enclosed cylinder/HEPA vacuum system method" are the preferable procedures to use. Both reduce the risk of exposure to airborne concentrations of asbestos by keeping the airborne concentrations of asbestos within permissible exposure limits. The effectiveness of these procedures can be verified by an industrial hygiene evaluation.

If it's not possible to use either method, personnel must implement effective engineering controls and use approved respiratory protection directed by AR 40-5: Preventive Medicine; 29 CFR 1910.1001: OSHA Asbestos Standard (effective 21 Jul 86); and TB Med 502: Occupational and Environmental Health Respiratory Protection Program.

It's also possible to be exposed to hazardous airborne concentrations when sweeping dry dust or when dumping a trash can containing asbestos dust. Use precautionary measures for these jobs, too.

These recommendations are general and should be supplemented with more rigid and specific guidance depending upon results of the required initial and periodic industrial hygiene surveys and evaluations. Contact your local MEDDAC/MEDCEN Preventive Medicine Service Industrial Hygienist for assistance.

POL Disposal

Hazardous material is defined as any substance or components of such that, when handled improperly, could or would expose one to risk or contaminate the environment. With this in mind, how many times have troops performing maintenance on their equipment caused a hazardous material (POL) spill? After the spill was cleaned up, what did they do with the compound they used to clean up the spill? Did they know that now they also had a hazardous waste product to dispose of? This article will discuss the proper disposal of petroleum, oil, solvents, and fuels, and their waste byproducts.

In the maintenance field, we deal with hazardous products every day. Some of these we

handle without giving a thought to what a spill could cause. Some of the products are used as cleaning agents, fuel for vehicles, and lube oils. Each of these has waste byproducts that must be disposed of in accordance with rules set by the Department of Transportation (DOT) and the Environmental Protection Agency (EPA).

For example, when we clean up a small oil spill with a few rags, the rags become a hazardous waste byproduct that must be shipped to the disposal site. Before we can do this, however, we must place them in a container that meets the standards set up in 49 CFR 101.1. The container also must be properly labeled. This is the minimum requirement simply to move the product from the maintenance area to a disposal site.

Unit maintenance SOPs should discuss proper disposal of waste oil and solvents. The SOP must conform to the laws and controls set up by DOT and EPA. The drum the product came in may be used for disposal. Copy all the information on the label and then paint the waste drum with traffic yellow paint from your local self-service supply center. Mark it with the words "Waste Products" in 4-inch letters and add the information you copied from the label. Make sure you don't mix products. In other words, oil should not be mixed with solvents or fuels. A normal motor pool would have as many as six 55-gallon drums, one each for waste oil products, waste solvents, waste fuels, oil rags, contaminated floor sweep products, and contaminated ground dirt. Each has different label requirements under 49 CFR 101.1. Hazardous waste product labels can be obtained from the safety office, facility engineer, or transportation office.

A post or installation that fails to meet requirements can be fined as much as \$25,000 a day per incident. That's a lot of money, and the Army may take UCMJ action against an individual soldier for not following procedures.

As maintenance personnel, it is our responsibility to ensure that hazardous materials and their byproducts are handled and disposed of in the proper manner. The dry sweep, rags, or other materials used to clean up spills in and around shops and motor park areas must not be put in the local dumpster or trash cans. The local facility engineers can assist you in determining the proper method of disposal. Call them when questions arise.

Operation Alert

The North Carolina National Guard conducted an inspection of its CUCV fleet and found that 107 out of the 198 inspected had loose steering gear mounting bolts.

The loose mounting bolts create a potential for loss of life, personal injury, or major damage to equipment if not corrected immediately.

Units using the CUCV family of vehicles should perform a one-time inspection of the steering gear mounting bolts. Bolts found to be loose should be tightened to 80 lb-ft (110n-M) in accordance with TM 9-2320-289-34. Figure 11-1 on page 11-3 displays the location of the bolts to be checked.

PS Magazine, issue 390, dated May 1985, also gives the location and procedures on how the inspection should be done.

Although the dash 10 manual does not list the steering gear mounting bolts as part of the operator's PMCS, commanders are encouraged to have their operators periodically check them.

Servicing Tires Causes Injuries

Tires are essential to the Army. They're everywhere, used constantly. There are tactical tires, combat tires, earth-mover tires, front and rear tractor tires. They have drop-center rims, semidrop-center rims, flat-base rims, advanced rims, military rims, and earth-mover and grader rims. Despite their differences, all tires have one thing in common; they all must be serviced.

Tires are constantly subjected to damage. They are cut by sharp objects and banged up by bad roads, stones, and road shocks in general.

People who service tires are subjected to injury, too. In FY 86, 60 people were injured while servicing tires. The leading injuries were fractures and strains, and the majority of them occurred to people who were lifting or inflating tires.

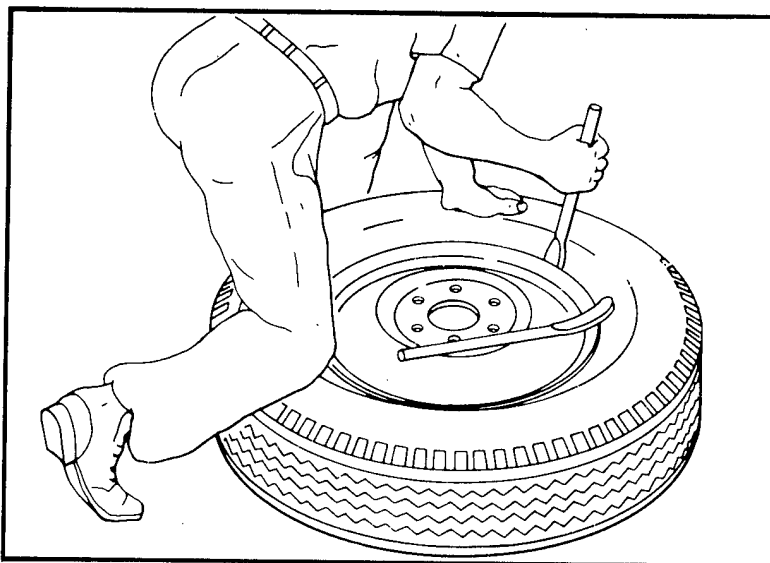
Lifting tires

Twenty-four of the 55 tire-servicing accidents occurred during lifting. Back strain, the most

prevalent injury, occurs because soldiers and employees try to lift loads that are too heavy, use the wrong lifting procedure, or do not use lifting devices or use them incorrectly. For example, one employee was reinstalling a 150-pound tire and wheel on a truck axle. He tried to lift the tire by himself without using a lifting device. His resulting back injury kept him out of work for 45 days.

Supervisors can help prevent injuries from lifting by—

- Eliminating as much manual lifting from the job as possible.
- Requiring that mechanical aids be used to minimize manual handling.
- Requiring physical conditioning of personnel.
- Conducting safe-lifting training.
- Supervising lifting tasks.



Inflating tires

The 17 accidents that occurred while personnel were inflating tires caused 21 injuries. Eleven of those injured suffered fractures; others had severe cuts to the face and head, concussions, compression of the vertebrae, and severe bruises.

Injuries occurring while tires were being inflated resulted because soldiers and employees were not using an inflation safety cage, were not using a long hose, were sitting on the tire, or used a cage that was not properly constructed.

In one case, five soldiers were refilling an M520 Goer tire. Neither the PVT, who was responsible for the job, nor the SP4 who was helping him, knew the proper procedures. The other three soldiers, an MSG, an SFC, and a PFC, offered to show them how it should be done. When the tire was about 2 inches from being seated on the rim, the soldiers laid it down with the split ring on the floor.

The SFC sat on the tire with his feet inside the rim while the PFC stood on it. The MSG, SP4, and PVT stood near the tire watching. As they continued filling the tire, the split ring came off with explosive force. The SFC hit the ceiling and then the floor, resulting in a compression fracture of his vertebrae. The PFC and the tire struck an overhead fluorescent light fixture and then the floor. The PFC suffered multiple fractures of his jaw, thumb, and facial structure. As the tire shot up, it struck the MSG and the SP4. The MSG suffered a concussion, the SP4's legs were bruised, and the PVT ended up with an injured eye.

To prevent injuries when inflating tires—

- **Always** use a safety cage when inflating tires mounted on rims with demountable side ring flanges or lock rings. This is the only approved method of inflating tires. Cages must conform to specifications in TM 9-2610-200-24 and TM 9-237. Cages must also be certified before use.
 - Never attempt to seat side ring flanges or lock rings during or after inflation. Improperly seated side ring flanges or lock rings could blow off.
 - Never overinflate any tire to seat tire beads.
 - Use only tools designed for tire mounting and demounting. Don't use pick-mattocks or sledgehammers for breaking down tires. Take a look at TM 9-243 for proper tool usage.
 - When in doubt about what to do, ask your supervisor for guidance before you continue.
- DA Pam 385-8: Back Injury Prevention outlines ways to prevent back injuries.

Tire cages

Inflation safety cages, generally called tire cages, should always be used when inflating tires mounted on rims with demountable side ring flanges or lock rings. The Army does not have a tire cage that units can order, and, according to Tank-Automotive Command (TACOM), there are no

plans to develop or obtain one. The inflation cage depicted in TM 9-2610-200-24: Care, Maintenance, and Repair of Pneumatic Tires and Inner Tubes, page 2-15, will meet all Army requirements and OSHA standards. The cost of the common bulk materials and manpower required to fabricate this cage is minimal when compared to commercial inflation cages.

Tire cages may be constructed in various sizes to meet the needs of the unit. Users may make multiple tire cages. However, a single tire cage can be constructed so that it will accommodate the smallest and the largest tire a unit uses. To do this, make sure the openings on the sides and top of the cage are small enough to contain projectiles from an explosion of the smallest tire that will be inflated in the cage.

It is not mandatory to anchor the tire cage to the floor, although doing so is recommended. Always ensure that the cage is placed at least 4 feet from any wall. Space on each side of the cage will help absorb the force of an explosion and help prevent movement of the cage.

Before a tire cage is used, its construction must be certified by facility engineers. Two inspections are required for tire inflation cages:

(1) Inspection by the installation's facility engineer before first use. This inspection ensures that sound welding techniques, proper materials, and appropriate dimensional characteristics have been used in cage construction. TM 9-2610-200-24 and TM 9-237: Welding Theory and Application are the reference manuals for this inspection.

(2) Visual inspection by cage users before each day's use. Users should inspect for missing, broken, or deformed members due to mishandling or abuse and severe pitting due to excessive corrosion. Cages having any of these discrepancies should be reported to the user's supervisor for determination of corrective action.

Tire cages will be inspected by facility engineers when—

- Cages are newly constructed.
- Cages have been damaged by rim separation and have been rebuilt.
- Cages have been repaired by using units.
- Requested by using units in regard to excessive corrosion.

There are no specific qualifications for the inspector, other than that he or she must represent the installation's facility engineering office and be familiar with requirements of TM 9-2610-200-24 and TM 9-237.

Tire cage components that are malformed or damaged by a tire explosion can be salvaged and used when the cage is rebuilt. However, the rebuilt cage must be inspected by the facility engineer before being returned to service.

Wrapping multipiece rims in chains is no longer authorized. Units in the field, away from installation maintenance shops and tire cages, should deploy with a tire inflation cage. TACOM is currently researching other alternatives to alleviate this burden while ensuring safe tire inflation operations in the field.

As a minimum service set, units should have on hand the items in Table 1. Some of the items come with the No. 1 Common Tool Set, while others must be ordered separately. All items are Class 9 and can be replaced by ordering them through PLL or supply rooms.

TACOM's April 1987 Technical Bulletin 43-0001-39-2 contains an article reflecting changes that will be included in TM 9-2610-200-24 in September 1987.

Table 1.—Minimum Service Set

NSN	Item
4910-00-441-8685	Airhose and gage for safety cage use
4730-00-729-7076	Chuck air lock: on male
4730-00-277-6948	Chuck air lock: on female
4910-00-806-1052	Constrictor, bead expander: passenger and light truck tubeless tires
4910-00-138-1819	Constrictor, bead expander: large tubeless tires
5120-00-516-4220	Fishing tool, pneumatic tire
5210-00-019-3050	Gage, depth: tire tread
4910-00-204-3170	Gage, tire pressure: general
4910-00-204-2644	Gage, tire pressure: large bar

Safety Inspection and Testing of Lifting Devices

The commander of each DA major subordinate command, installation, and activity is responsible for inspection, testing, and maintenance of all authorized lifting devices and will designate the appropriate support activity to perform these services. The chief of the safety office or the military equivalent (safety officer) will assist and advise the commander and equipment manager in establishing programs for carrying out these responsibilities.

The following guidelines apply to all cranes, hoists, slings, lifting cables, forklifts, and jacks.

Lifting devices should be inspected both daily and periodically in accordance with TB 43-0142 and TM 738-750. The daily inspection of lifting devices shall be performed by the operator before use.

Lifting devices that have been idle for 1 month or more but less than 6 months will be inspected in accordance with daily inspection criteria. In addition, a thorough document inspection of wire ropes (if applicable) in accordance with criteria in appendix C, paragraph C-1a, TB 43-0142, will be completed.

Daily inspections should comply with the criteria specified in the appropriate technical manual or, in the case of off-shelf products, as the manufacturer recommends.

Leaks on hydraulic systems should be classified as follows:

- **Class I.** Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.

- **Class II.** Leakage of fluid great enough to form drops but not enough to cause drops to drip from item being inspected.

- **Class III.** Leakage of fluid great enough to form drops that fall from the item being inspected.

Any item found to be unsafe should be tagged and put in an area so no one will use it.

Quarterly and annual inspections should be listed on DD Form 314.

Equipment faults found during daily inspections should be listed on DA Form 2404, which should be attached to the equipment.

The following are recommended minimum inspection checks:

- Identification of cracks and malfunctioning or worn hooks and latch attachments.
- Checking ropes and cables for improper rigging and damage.
- Checking chains for wear, twist, stretch, and distorted links.
- Inspecting electrical apparatus for malfunction, excessive deterioration, and dirt or moisture accumulation.

- Proper marking of load rating.

- Check for missing or broken bolts and rivets, hydraulic leaks, worn screw threads, and cracked rack teeth.

Power Generator Grounding

The proper grounding of power generating equipment is a must for safe operation. If a short circuit occurs somewhere in the generator or in the distribution system, stray electrical current might cause injury or death to personnel and damage to equipment.

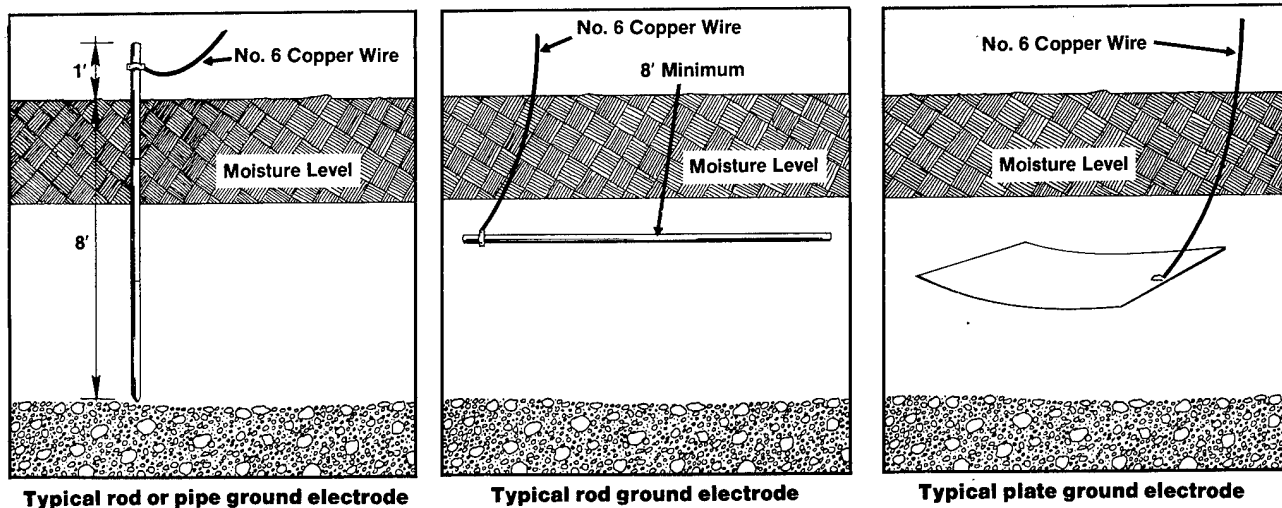
There are three basic ways to ground tactical portable power generation equipment.

- **Rod electrodes.** The standard ground rod used by the military is a $\frac{5}{8}$ -inch copper rod with three 3-foot sections. The rod electrode must be driven at least 8 feet into the ground. If this can't be done, the electrode can be buried in a horizontal trench below the moisture level. In both situations, the rod must be at least 8 feet long (see illustration).

- **Pipe electrodes.** A clean metallic pipe of at least $\frac{3}{4}$ -inch trade size can also be used, but it must be driven at least 4 feet into the ground. If this can't be done, an 8-foot pipe can be buried in a horizontal trench below the moisture level.

- **Plate electrodes.** A buried plate electrode also can be used. Plate electrodes should be not less than 10 inches wide and 10 inches long (100 square inches). If an iron or steel plate is used, it must be at least $\frac{1}{4}$ -inch thick and of nonferrous metal at least .06-inch thick. Plates must be buried below the permanent moisture level (see illustration).

To ground connections, put one end of the ground cable (not less than No. 6 AWG) to the ground terminal of the set and tighten the nut securely as outlined for the generator in FM 20-31: Electric Power Generation in the Field. Connect the other end of the cable to the grounding electrode with the special grounding clamp specified in FM 20-31.



Parking Brake

Repairers and operators should be aware that if they are doing maintenance in the cab of a 2 1/2-ton or 5-ton series truck they can easily disengage the parking brake if they accidentally bump the handle.

Soldiers should remember to put chock blocks under each side of the vehicle, below the intermediate wheels, to prevent the vehicle from rolling backwards or forward.

Towing Safely With the M88A1

Cancellation of the Improved Recovery Vehicle program puts the burden of towing on the M88A1. Towing with the M88A1 and like vehicles will become riskier as ongoing fielding of the 65-ton M1A1 and future fielding of the 68-ton M1A1 (HV armor) puts heavier equipment in the field.

A review of M88A1 towing accidents showed that damage most often resulted when the towed tank pushed the M88A1 while descending a steep grade or when the M88A1 attempted to stop.

Countermeasures include the following—

- When towing an M1 Abrams, always use another M1 as a hold-back vehicle, even when using a tow bar.
- Never allow anyone to ride in or on an M1 while it is being towed.
- Always tow at 5 mph or slower when using a tow bar. Tow at 2 mph or slower when using a tow cable.
- Never make sharp turns in first gear. Make gradual wide turns.
- Never make sudden stops.
- Care must also be taken in other areas. Soldiers must be protected from the Abrams exhaust heat when hooking and unhooking towing devices from the towing vehicle. Special care should be taken to avoid skin contact with hot tow bars when unhooking.

In addition, when towing one M1/M1A1 with another, the angle formed from the tow pintle to the tank's upper lifting/towing eyes can "push" the tank doing the towing, especially when going downhill. The downward angle of the tow bar may also cause it to bottom out when cresting hills or traversing ditches.

Units still using the unimproved tow bar clevis should be aware of the high risk for tow separation due to tow bar failure. An improved clevis that is expected to remedy the problem has

been fielded. The improved clevis is NSN 5340-01-067-2908. Full-up tow bar, which includes the improved clevis, is NSN 2540-01-267-2912. The new clevis is suitable for towing cross country and has a rated capacity of 70 tons.

Servicing Tires Safely

Tires are essential to the Army. They're everywhere, used constantly. There are tactical tires, earth-mover tires, and front and rear tractor tires. They have drop-center rims, semidrop-center rims, flat-base rims, advanced rims, military rims, and earth-mover rims. Despite their differences, all tires have one thing in common. They all must be serviced—and serviced safely!

Tires are constantly subjected to damage. They are cut by sharp objects and banged up by bad roads, stones, and road shocks in general.

People who service tires are subjected to injury, too. In FY 88, 61 tire-related accidents were reported. The most common injuries were fractures and strains.

Repairing and inflating tires

Fifty-six accidents occurred to personnel repairing and servicing tires. Inflating tires was the leading cause of accidents. Other accidents involved removing, demounting, and mounting tires. Injuries occurred during inflation to personnel not using an inflation safety cage or long hose, sitting on the tire, or using a cage that was not properly constructed. Improper tire size caused seven of these accidents. For example, a 16-inch tire was mounted on a 16.5-inch rim and then overinflated without a safety cage. The tire exploded, and the soldier broke his hand.

Another seven accidents involved lifting. Back strain, the most prevalent injury, occurred when soldiers tried to lift loads that were too heavy or used lifting devices incorrectly or not at all.

Injury prevention is easy

- Always use a safety cage when inflating tires mounted on rims with demountable side ring flanges or lock rings. This is the **only** approved method of inflating tires.
- Never use unapproved methods such as placing a tire with the lock ring facing down, or with chains or straps around the rim. There is no authorized substitute for the safety cage.
- When adding air to a tire that has less than 80 percent of the recommended pressure, whether on or off the vehicle, put it in a tire cage. (This warning is being added to the PMCS in the operator's manuals for all tactical wheeled vehicles.)
- Never attempt to seat side ring flanges or lock rings during or after inflation. Improperly seated side ring flanges or lock rings can blow off.
- Never overinflate any tire to seat tire beads. If both beads do not seat properly when tire pressure reaches 40 psi, completely deflate the assembly. Reposition the tire on the rim, relubricate, and inflate. After beads are fully seated, pressure may be increased as specified by the vehicle technical manual.
- Use only tools designed for tire mounting and demounting. Don't use pick-mattocks or sledgehammers for breaking down tires. Take a look at TM 9-243, Care and Use of Hand Tools and Measuring Tools, for proper tool usage.
- Use approved tire lubricant to aid in mounting and demounting tires. Never use grease. It causes rubber to deteriorate. Lubricant, NSN 2640-01-282-2849, has the consistency of grease, which aids in sealing the bead to the rim.
- When in doubt about what to do, ask your supervisor for guidance before you continue.

Tire cages provide protection

Inflation safety cages, generally called tire cages, should always be used when inflating tires mounted on rims with demountable side ring flanges or lock rings. It is a good idea to use the cage with other type rims also. The inflation cage shown in TM 9-2610-200-24, Care, Maintenance, and Repair of Pneumatic Tires and Inner Tubes, will meet all Army requirements and OSHA standards.

Cages may be built in various sizes to meet the needs of the unit. Users may make multiple tire cages, or a single cage may be built to accommodate both the smallest and largest tires a unit will repair. This requires making sure the openings on the sides and top of the cage are small enough to contain projectiles from an explosion of the smallest tire inflated in the cage.

In addition, users must always ensure that the cage is at least 4 feet from any wall. Space on

each side of the cage will help absorb the force of an explosion and help prevent movement of the cage.

Before a cage is used, its construction must be certified by facility engineers. TM 9-2610-200-24, TM 9-243, and OSHA Standard 1970.177 provide the certification standards. In addition to inspecting new cages, facility engineers will inspect any cage that—

- Has been damaged by rim separation and repaired.
- Has been repaired by using units.
- Is corroding excessively and for which the unit requests an inspection.

Cages must be visually inspected each day before use. Inspect for missing, broken, or deformed members due to mishandling or abuse. Check for severe pitting due to excessive corrosion.

Field conditions don't change the rules

Placing multipiece rims lock ring down or wrapping rims in chain or straps is not authorized. Units in the field, away from installation maintenance shops and tire cages, should deploy with a tire inflation cage.

Mistaken identity on tires/rims can cause problems

The CUCV and the M880 series rims can easily be mistaken for each other. Appearance and lug hole patterns are similar. Correct rim size can be determined by a stamped size 16x6 on the outside of the CUCV rim. The M880 series rim is stamped 16.5x6.75 on the inside of the rim. TACOM recommends that each unit having CUCV and M880 vehicles identify and stencil each rim. The stenciling process can be accomplished using white paint and a minimum 2-inch stencil size. Stencil "CUCV" or "M880" internally on the drop center well near the valve stem hole. This location will not interfere with camouflage requirements and is least susceptible to dirt and grease buildup. TACOM recommends the stenciling process be done during the next scheduled maintenance interval.

To make the job easier

All units should have certain tools on hand. Some items come in the No. 1 common tool set while others must be ordered separately. All items are Class 9 and can be replaced through PLL or supply rooms. A minimum service set includes:

- Air hose and gauge, NSN 4910-00-441-8655.
- Chuck air lock, male, NSN 4730-00-720-7076.
- Chuck air lock, female, NSN 4730-00-277-6948.
- Constrictor, tire (M880 and CUCV), NSN 4910-01-242-1370.
- Gauge tire pressure, NSN 4910-00-203-2170.
- Gauge tire pressure, NSN 4910-00-204-2644.
- Lubricant, tire, NSN 2640-01-282-2849.

Selected Accident Briefs

Maintenance

The soldier and his supervisor were turning a 12-volt battery 180 degrees in the battery box of an M48A5 tank. They had not removed the ammo from the tank nor the ground cables from the battery. As the soldier turned the battery, a live positive cable touched the base of a 105mm cartridge case. Electricity arced from the mouth of the cartridge case to an ammo retainer clamp around the cartridge case. The electricity melted holes in the case. The propellant ignited and ejected the HEAT projectile out through the ammo loader's hatch and into the turret. The flash fire caused third-degree burns over 65 percent of the soldier's body and minor burns to the supervisor's face and upper body.

Causes. The soldier and his supervisor failed to download the ammo before working on the battery. They also failed to disconnect the ground cables despite the warning decal on the battery box. A rubber pad used in the ammo retainer clamp to insulate and protect ammunition had vibrated loose and was missing. Maintenance personnel had failed to replace this insulating pad.

Countermeasures. Take positive command action to assure that established by-the-book procedures are strictly followed in performing any type of work on uploaded tanks. Allow no shortcuts and be particularly watchful for unsafe acts and violations of procedures. Closely

supervise unit maintenance and stress the high potential for accidents caused by failure to properly perform all tasks, regardless of how routine or minor they may seem. Demand that close attention be given to every detail of every job.

Failure to follow procedures

The M551 armored reconnaissance airborne assault vehicle was being moved from the consolidated maintenance area to an assembly area to be parked as the last vehicle in a column formation. The assigned driver was functioning as the ground guide, and the assigned gunner was functioning as the driver. With the ground guide positioned between the two vehicles, the driver moved to within 10 feet of the parked vehicle and stopped. The ground guide motioned the driver to move the vehicle closer. As the driver began moving the vehicle, it surged forward, and in spite of reported attempts to stop it, he was unable to do so. The M551 hit the last vehicle in the column, crushing the ground guide between the two vehicles.

Neither the ground guide (assigned driver) nor the driver (assigned gunner) was licensed to operate the M551. However, both men had performed as track vehicle drivers and accumulated hours of driving experience. There were no records available to indicate that either soldier had received any specialized training in this vehicle.

Investigation revealed that:

- While attempting to move the M551 into a parking position, the driver inadvertently depressed the accelerator rather than the brake. The M551 hit a parked M551, crushing the ground guide between the two vehicles. The driver had not been properly trained or licensed to operate the M551.
- The ground guide failed to follow proper ground guiding procedures when he remained between the two vehicles during parking operations.
- The driver failed to stop the tank when he saw the ground guide between the vehicles.
- Driver training was decentralized to the vehicle commander level and consisted of test drives behind the motor pool. There was no POI or guidance for the company or battalion for an organized track vehicle operator training program.
- Personal equipment was stored within the visual modifications of the track, reducing the driver's field of view.
- Vehicle and maintenance forms showed inadequate unit PMCS, inadequate scheduled services, and inadequate involvement in the Army Oil Analysis Program.
- No member of the crew's chain of command was in the assembly area during this period.

Actions taken. The importance of adhering to established SOP for ground guiding has been stressed to all leaders and soldiers. Policy states that vehicle commanders will remain with their vehicles during maintenance periods.

A formal program of company-level training and battalion-level testing has been instituted.

Performance of quarterly services was centralized at battalion level. Maintenance forms and records are under battalion control following conversion to the "J" MTOE series.

Improper procedures

The left front wheel had been removed, and the 2 1/2-ton cargo truck was supported by a jackstand. The emergency brake was inoperative, so the truck was parked in gear. No chock blocks were under the rear wheels, and the battery was not disconnected. A PFC was sitting under the vehicle next to the axle when another mechanic reached inside and started the engine to check the wiper system. The truck moved forward and fell off the jackstand onto the PFC. He died of his injuries.

Jewelry accident

The sergeant was unloading 55-gallon drums of solvent from a 5-ton dump truck. After unloading one drum, he put his hand near the tailgate retaining bracket and jumped from the rear of the truck. His ring caught on a spot weld, and his finger was torn off at the knuckle.

Improper procedures

The front bumper of a 5-ton dump truck was 2 feet from the maintenance bay wall. Without shifting the transmission into neutral, the SP4 started the engine to straighten the wheels so the mechanic could get to the left front axle. The mechanic stepped between the bumper and the wall just as the engine was started. When the SP4's foot slipped off the clutch, the truck lurched

forward, crushing the mechanic against the shop wall. He died of internal injuries.

Untrained operator

After cleaning and relighting an oil-fired space heater, the sergeant poured about 2 gallons of diesel fuel into the heater to prime it. The fuel overflowed into the heater's drip pan and was ignited. When the sergeant sprayed the fire with a dry chemical extinguisher, the burning fuel splashed onto a wooden wall 2 feet away. The wall ignited, and the supply building and its contents were destroyed. Damage costs totaled nearly \$155,000. The sergeant was neither trained nor authorized to operate the heater.

Forklift

During motor stables, one soldier did PMCS while the second recorded the deficiencies. They found the forklift's fan belts worn. The first soldier moved into the driver's seat and started the motor, just as a third soldier came by, asked what was wrong, and reached in to test the belts. The driver made an improper decision to start the forklift without checking to see that all personnel were clear. The soldier who reached in to check the fan belts did so without regard to what others were doing. Both soldiers should have communicated more clearly.

Running engine

Missing wedge bolts were being replaced while the M1 tank was stationary. To make it possible to replace additional wedge bolts, the PFC moved the tank forward. He was told to close the top grille doors. As he came out of the driver's hatch, he inadvertently placed the tank in reverse. A soldier's right arm was caught between the track and the road wheel. Drivers need to shut off the engine and set the brake before getting out of the driver's compartment. Soldiers should not reach across the track of a running tank.

Safety glasses

They were having difficulty loosening the sprocket while changing the left-side final drive on the M2 Bradley. The soldier picked up a sledge hammer and struck the sprocket twice. A piece of metal broke off and lodged in the soldier's right eye. He was hospitalized for removal of the metal. Personnel should always wear safety glasses when performing tasks that may endanger their eyes.

Brace breaks

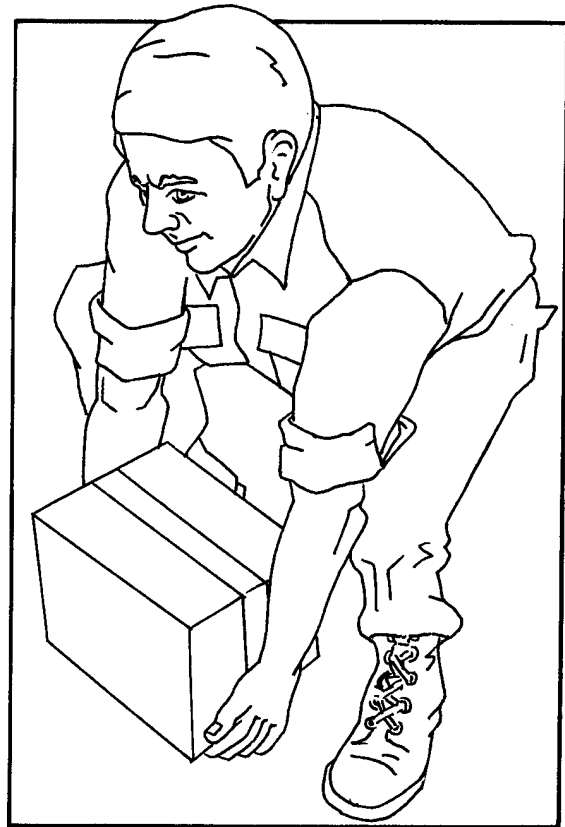
The tire was secured in the tire cage. The sergeant had put in more than 30 pounds of air when the tire popped, the ring blew, and the cage brace broke, allowing the sides to expand. The tire cage hit and injured the sergeant's knee. TM 9-2610-200-240, page 2-14, warns personnel to remain at least 10 feet from the tire being inflated. As a minimum, a 10-foot-long hose extension must be connected between the inflator gauge and the valve stem.

Lifting device needed

The soldier helped lift two smoke generators from the trailer to the workbench. Both times, he had to hoist the generator as he stepped over the drawbar of the trailer. Although he had help in both instances, the soldier injured his back. For items too heavy or awkward to lift even with help, shop personnel should use a forklift or other mechanical aid.

Wrong move

The employee placed a 10-foot-long, 2-inch-diameter rubber suction hose into his service truck. When he saw that a 2-foot section was sticking out the back, he bent forward, twisted



slightly, and shoved the hose. This simple act of twisting his back while pushing caused him to pinch a nerve so severely he was brought to his knees. Whether lifting or pushing, avoid twisting. Keep the back straight and use the leg muscles to lift or shove.

Failure to follow procedures

The private was using the upright drill press to drill through a piece of sheet metal that was not secured in a vise. As the drill passed through the metal, it grabbed and started spinning the piece of sheet metal. The private's left hand was cut.

Protective gear

While the soldier was replacing the clutch assembly on a 2 1/2-ton truck, some metal fragments fell from the transmission into his eye. He should have been wearing safety glasses.

Split-ring explosion

Five soldiers were in the battalion motor pool changing tires on an M915 tractor-trailer truck. A private was sitting on the tire with the split ring facing up. An SP4 warned him that this was dangerous, then moved on to remove a tire from the other side of the truck. The private turned the tire upside down so that the split ring was down and began to inflate the tire once again. The tire exploded, and the split ring struck the private on the arm, causing severe injury.

A tire cage should **always** be used to inflate split-ring tires (TM 9-2610-200-24).

Brake failure

The forklift operator was trying to align the forks with a pallet of parts. As he made a quick 180-degree turn, he stepped on the brake pedal. When the forklift did not respond, the operator yelled, "Look out." A soldier working near the pallet of parts had no time to react, and his left leg was pinned between the pallet and one of the forks. The soldier's injury resulted in a permanent partial disability.

The brakes were inoperative when the forklift operator began using the forklift. He should not have used the forklift knowing it had no brakes. The soldier working near the forklift should have been warned to be alert while the forklift was operating in his area.

Improper procedure

During the maintenance portion of a battalion howitzer section evaluation, the transmission oil pressure gauge on a howitzer quit registering. Even though the engine was running, the soldier reached in to check the connection on the sending wire. A loose strap on his glove became caught in the fan tower, pulling his hand into the blade.

The soldier failed to stop the engine before performing maintenance. Also, wearing loose clothing or jewelry while performing maintenance is dangerous.

Improperly fitted safety goggles

The mechanic was using a metal object to chip slag from around the drain plug of an M113 so the plug could be removed. A piece of slag fell behind his safety goggles and entered his left eye. Because his safety goggles did not fit properly, his protective gear couldn't protect him.

Wrong procedure

The soldier was in the motor pool bay working on a generator battery. Nearby, another soldier was using a metal hammer to separate a drive shaft and universal joint. Metal particles flew into the arm of the soldier working on the generator, becoming imbedded.

Instead of using the metal hammer on the metal components, the soldier should have used a brass drift or a press to remove the universal joint from the drive shaft. Also, a shield should have been used between the two workers.

Poor crew coordination

The M1 gun tube was on manual as the soldier climbed into the tank to check the batteries' hookup sequence. The crew announced power but did not see the soldier hunched low over the batteries. When the MRS (muzzle reference sensor) lever was inadvertently engaged and TC's palm switch override engaged, the soldier underneath the gun was crushed.

The unit now uses a retaining strap for the MRS lever to prevent accidental engagement. They should have inspected the area to ensure no mechanic was in danger before lowering the gun tube.

Improper procedures kill one

Although he was not licensed to operate a forklift, the shopworker raised a wooden pallet 10 feet in the air to use as a platform. Standing on the raised pallet, he was working on an air line to a hoist when he lost his balance and fell. He landed in a tank of 205-degree manganese phosphate. He died 3 days later.

The victim was neither trained nor authorized to perform the maintenance task he was trying to do, and he failed to take proper safety precautions. The job required the use of a safety pallet or a lifeline, and the forklift should have been operated by someone who was trained and authorized to do so.

Using a lift truck as an elevator for employees should be done only with a safe platform that is securely seated to the forks, fastened to the wall, and provided with handrails and toeboards.

Fingers amputated in winch

The sergeant, the specialist, and the private were repairing a winch cable on the front of a 2 1/2-ton truck. After winding the cable onto the winch, the sergeant, while maintaining tension on the cable, gave instructions that a little cable be let out so that the private could attach it to the bumper. The specialist, in the cab, could not hear over the noise of the running engine, and he misunderstood the instructions. Instead of letting the cable out, he took it in. The sergeant's right hand became entangled in the cable, and three of his fingers were amputated.

A breakdown in communication caused this accident. Constant, clear communication is a must anytime two or more people are working together—each must know what the others are doing at all times. In addition, safety gloves might have prevented or reduced the injury to the sergeant's right hand.